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VOLUME V **8-9** 1950

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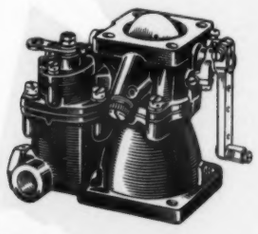

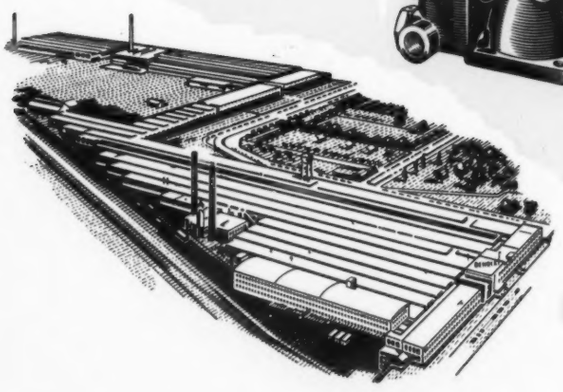

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Volume V — No 8-9 — 1950

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SINCE its foundation in 1933, Air France has come a long way. In recognition of its merits, Air France on January 15th, 1950, was awarded the Grand Medal of the Kuhlmann Foundation. Today Air France covers the world with its 125,000-mile network of scheduled air services. Outstanding specialist in long-range service, a type of operation which it pioneered, Air France links the Metropolis with the farthest corners of the earth forty times a week. Its DC-4s, "Languedocs" and "Constellations" travel the sky lanes of the Near and Far East, of Australasia, the New Hebrides, of New Caledonia, of North Africa, of Equatorial Africa and of the two Americas.

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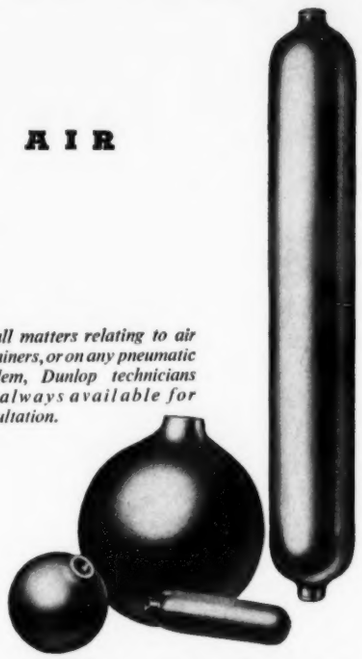

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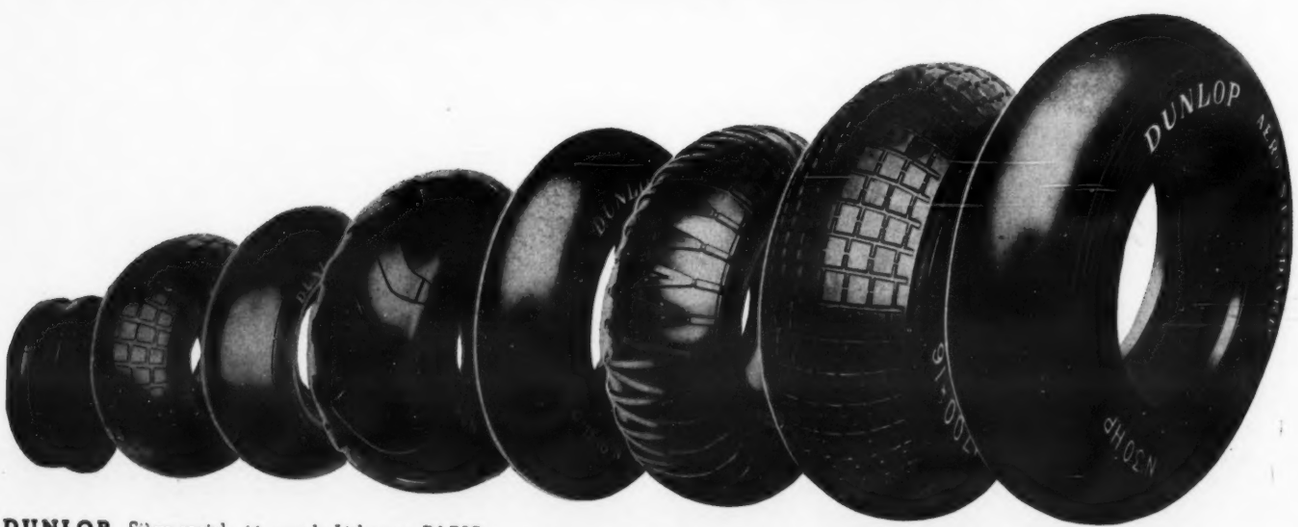

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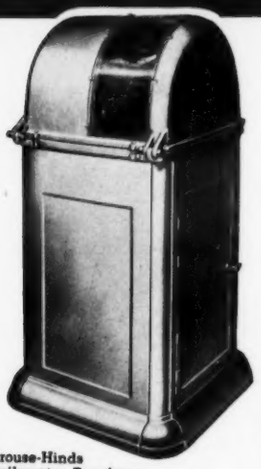

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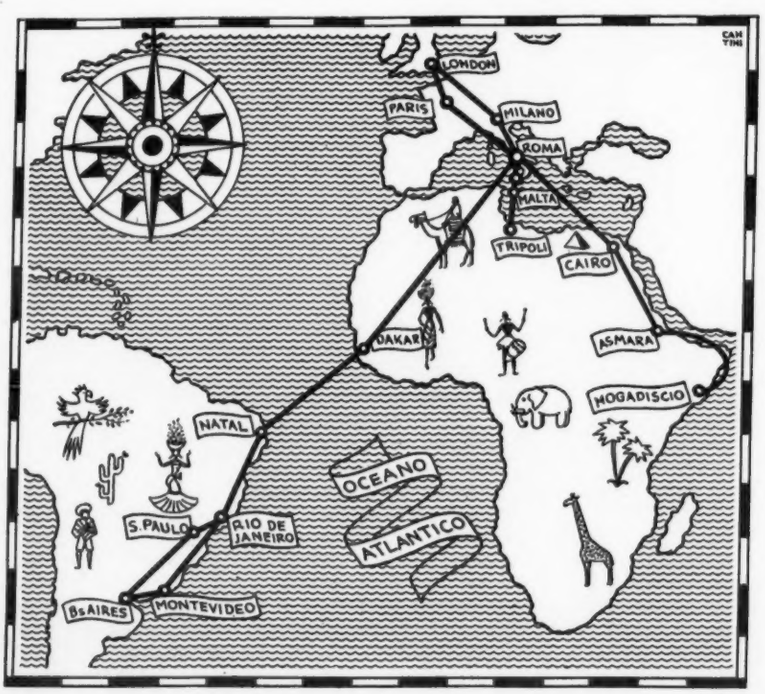

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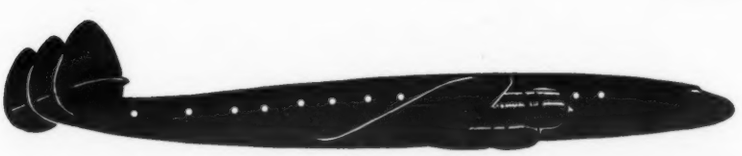

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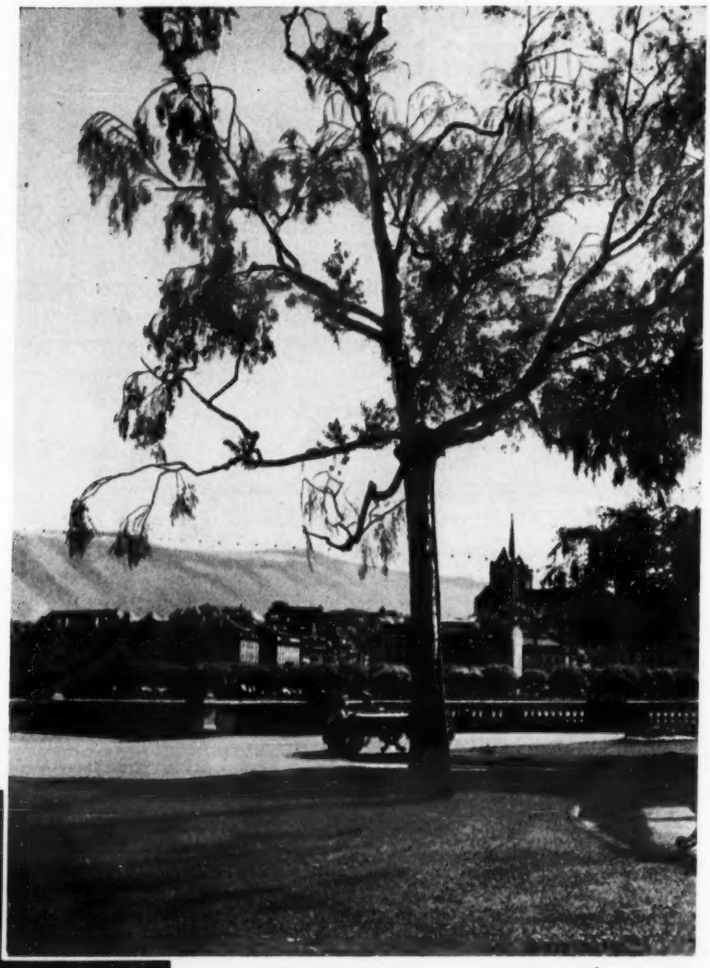

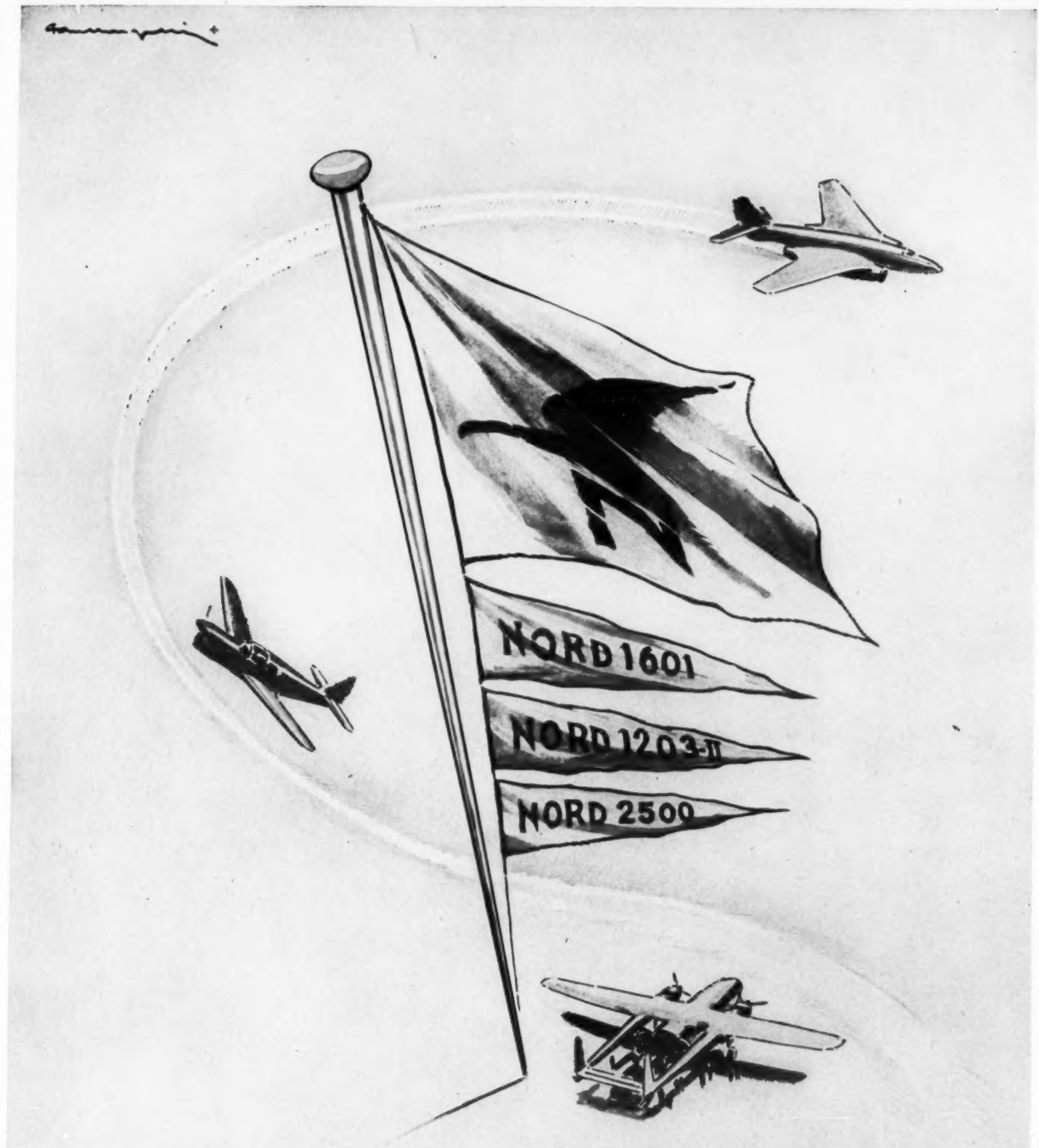

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DEPEND ON DOUGLAS

30TH ANNIVERSARY YEAR

Parent Body or Cooperative Service Organisation ?

Theory and Practice

Once before—last year, we had the privilege of devoting a special number of *Interavia Review* to a red-letter event on the international air transport calendar—the Annual General Meeting of the International Air Transport Association (IATA). We published a "Who's Who" of IATA and of its member companies, and our efforts met with wide approval. As a result, we decided to try again.

Our intention last year was primarily to offer our congratulations to the Association, on the occasion of what it regarded—though during the war years, it virtually ceased to exist—as its 30th birthday. In effect, IATA was founded in 1919 originally on an European basis. We wished to add our own cheers to those which were ringing in the ears of delegates assembled at The Hague, native city of the erstwhile International Air Traffic Association. This year, however, there is no jubilee to celebrate. Facts alone must be the subject of our dissertation.

*

IATA's Director-General, who is well-known for his personal charm, is wont to lighten and enliven discussions on serious matters with a series of apt digressions. Although we do not pretend to be able to compete with him in this respect, we shall also preface these considerations with a short anecdote culled from our personal store of reminiscences, one which has the singular quality of being true in every particular.

Like flowers in springtime, each year brings forth its crop of Conferences, Congresses, Assemblies and Committee Meetings. Even the Congress of Vienna belongs to this ephemeral category, and the fact that it has gone down in history as an especially successful event is due to two main causes : one, the delegates and committee members went back home as soon as they had achieved the desired result, and second, they stayed there. Of course, it must not be overlooked that the proceedings took place under the auspices of two personalities of quite exceptional brilliance—Talleyrand and Metternich. Not every Conference has the good fortune to be able to wind up successful negotiations by adjourning

This picture shows Prince Bernhard of the Netherlands opening the Fifth General Assembly of IATA in 1949. Dr. Albert Plesman, President of KLM, who was Chairman of IATA for 1949-50, is on his left, while on his right is IATA's Director-General, Sir William P. Hildred.

"sine die." In fact, by far the greater majority of international assemblies suffer the opposite fate. And since the creation, after World War I, of the League of Nations, that panacea to end all wars, with its endless conferences and council meetings and committees and commissions, the situation has deteriorated further.

The old League of Nations was divided up into a number of sections or permanent committees, among others, the so-called "Section du Transit," which dealt with transportation matters. It followed the usual pattern of such organizations, managed to consume the appropriate amount of stationery and printed matter and never did anyone any harm . . . As international transportation consists of several different branches, this Transport Committee was accordingly provided with Sub-committees, including one for Road and another for Air Transport.

Believe it or not, but it's the naked truth . . . The Sub-committee for Road—or automotive—Transport was headed by a lady of uncertain age, who in her youth had been lucky enough to build up some kind of social contact with members of the Foreign Ministry of a certain European country. This, of course, was a recommendation in itself, and in addition the lady was quite talented. Only one thing was lacking to enable her to achieve perfection as an expert in road transport matters : she did not possess the faintest inkling of the nature of an automotive vehicle and had never touched a steering wheel in her life . . . Her colleague who dealt with air transport affairs was a young man of good family, whose father—unless our memory fails us—owned a freight forwarding business. Except in pictures, throughout the first years of his admittedly beneficial activity he had never even set eyes on live aircraft . . .

That was how committees were habitually run in the bad old days. At present matters are, of course, quite different, and the people sitting in these commissions are all experts of the first water in their respective fields . . .

*

The IATA Organization

The International Air Transport Association's main offices are situated in Montreal, Canadian city newly promoted to the status of capital of world air transport. To house IATA and ICAO, the two key organizations in worldwide air transportation, the Canadian Government has built the International Aviation Building, a veritable palace, a note on which will be found elsewhere in this issue.

To choose its President, IATA holds an annual election among chairmen, Presidents and Managing Directors of member companies. This year, Dr. Albert Plesman, President-Director of KLM Royal Dutch Airlines, will hand over the presidency at *IATA's Sixth Annual General Meeting* which is scheduled to take place *from October 16th to 20th at the Fairmont Hotel in San Francisco,* to Warren Lee Pierson, Chairman of Trans World Airlines.

The executive body of IATA, which has hitherto consisted of three members, will be

increased to four by this autumn, including the Director General, Sir William P. Hildred, former Director-General of Civil Aviation in Great Britain ; the Treasurer, Dr. H. J. Gorecki, one-time member of the Board of the Polish national airline, LOT ; the Secretary, J. A. MacD. Henderson, who acts as a kind of Master of Ceremonies ; while the newly-created post of Deputy Director General is due to be filled shortly by another well-known figure in civil aviation.

Apart from these, IATA includes other prominent personalities who do not belong to the small group of top officers. Two at least deserve special mention : the Polish engineer Stanislaus Krzyczkowski (a name which, despite its complicated spelling, ought to be remembered !), responsible for the Association's technical activities, and S. Ralph Cohen, the Public Relations Officer, who fulfils his duties of keeping the public informed about IATA activities by resorting to every method known to an experienced American journalist and propaganda expert.

While IATA's Head Office is in Montreal, the Association boasts four Branch Offices : the New York branch at 165 Broadway, the seat of the First Traffic Conference, is responsible for North and South American affairs ; the Paris branch at 76-78 Champs-Elysees, is the seat of Traffic Conference No. 2 and deals with matters relating to Europe, Africa and the Near East ; the Singapore branch, with offices in Ocean Building, is the seat of Traffic Conference No. 3, and is concerned with air transportation affairs in the Middle and Far East and in the South Seas. These three branches between them cover the world's main traffic areas. In addition, IATA runs its own IATA Clearing House in London, to which 32 of the Association's present 62 member companies now belong.

At the end of its fifth year of operation *IATA had 64 Active and six Associate Members.* At the end of the sixth year there were *62 Active and five Associate Members.*—The following changes took place during the past year : Six companies withdrew from Active Membership, namely, Air India Ltd. ; British South American Airways Corp. ; Eastern Air Lines ; Hongkong Airways ; Indian National Airways ; Skyways (East Africa) Ltd. *Newly admitted as Active Members* were East African Airways ; Linee Aeree Italiane ; National Airlines (Miami) and Chicago Southern Air Lines. Two companies left the roster of Associate Members : Companhia de Transportes Aereos (Lisbon) and East African Airways, which has changed over to the Active List. One of the largest American carriers, Eastern Air Lines, has cancelled its Active Membership and become an Associate Member. But it must not be thought that the IATA set-up ends here ; on the contrary, the Association has numerous other off-shoots, of which only the four main ones, the Financial, Legal, Technical and Traffic Committees, can be mentioned within the space at our disposal.

In the spring of 1950, for example, the IATA Technical Committee met at Asbury Park, N.J., on the East Coast of the USA to attend a Symposium on the maintenance and operation of turbine-powered aircraft. The word "symposium" has no connection with revelry in Ancient Greece, as might be surmised, but simply means a discussion, in this case devoted to the operational characteristics of jet transports. The conference confined itself to making recommendations.

*

IATA's aims

Broadly speaking, an orchestra is as good as its conductor. Let us be quite frank about it : IATA's Director General, Sir William P. Hildred, wields the Association's baton very skilfully. In addition to being photogenic,

Sir William P. Hildred, Director-General of IATA.

he is, at once, an artist of the spoken word, a first-rate organiser and a feast for the eyes of the wives of airline officials who grace the final banquets with which IATA's General Assemblies invariably wind up. In short, a past master at his job.

Let us now recall the words with which he laid down the future programme for air transportation in 1948 and which were quoted again in the IATA Bulletin for June, 1950, and try to compare them with what has been achieved so far :

> "The international airlines need uniform statistical and accounting methods to cut down airline staffs ; a Clearing House doing a hundred million dollars a year ; unanimity of view, convincing and forceful, on international legal matters ; a safe and sober flow of recommendations to the International Civil Aviation Organization on technical matters ; a sturdy rate structure, agreeable agency arrangements and uniform procedures in traffic matters ; and a longer periodicity in the Traffic Conferences. Alongside these desirable things, I would also like a smaller budget, less frequent meetings, less talking, less writing, more flying, and more revenue for the airlines."

Now this reads well and does indeed constitute a fine programme. And in fact, Sir William can note with satisfaction in this year of grace 1950 that—to take but one example—the turnover of the IATA Clearing House in London has already reached $200,000,000, and that it managed to survive the threat to its very existence which arose last years in consequence of the European devaluations. Whether he feels equally satisfied with developments in the field of aviation legislation, with the extent of indispensable reductions in airline personnel, elimination of unproductive paper-work or with the revenue of all his member companies is a moot point.

*

Anyway, Sir William is doing his best. Not only is his active brain continually occupied with all IATA's present and future problems, but he does not shrink from the most arduous journeys. The June issue of the IATA house organ contains a description, complete with map, of a round flight covering most of Central and South America which he recently undertook, accompanied by the Head of his New York office. The warmth of the welcome given to him throughout his journey was equal only to that of the climate. In this manner, the Director-General sought to achieve closer contact with the numerous IATA members in South America, whose only link with the Association lies through the permanent IATA branch office in New York. Personal contact is always useful, but, of course, such trips cannot have immediate repercussions on the economic development of air transportation in the regions visited.

But a brief glance at the list of events on this year's aviation calendar will suffice to show how unceasingly IATA strives to increase the knowledge and experience of member companies by frequent exchanges of opinion : three sessions in Montreal, plus the General Meeting in San Francisco, are scheduled for October ; in November, there will be a Navigation Conference in Cairo and a Technical Conference in Paris ; while during the same month clearing negotiations are scheduled to take place in New York, as well as discussions on aviation insurance. A further six meetings will take place in London and Montreal in late autumn, and it is interesting to note that matters affecting air transport in Europe and the Mediterranean area are to be solved in a Canadian city.

Parent Body or Cooperative Service Organisation ?

Judging by its title, IATA purports to be nothing but an association of companies engaged in air transportation. Its aims, of course, are world-wide.

In May, 1949, Sir William Hildred wrote in a letter: "One worldwide IATA is an ideal worth striving for. My life in trying to foster this ideal is one long rush, with no personal life, no time for rest... but it is worth it." This is an admirable and praiseworthy attitude, and one can well understand why for several months now, Sir William has been casting around for a Deputy Director-General to relieve him of some of his duties.

But—and this is a question which must be faced sooner or later—is IATA really a worldwide air transport association (in which case, as a private organization, it would achieve something of a monopoly)?

In actual fact, IATA has succeeded in bringing about a number of agreements, conventions and other links binding together the 62 more-or-less leading airlines who are members of the association. This situation is openly acknowledged and testified to by the words "Member of the International Transport Association (IATA)" which are printed on the tickets, timetables or letterheads, of most of these companies.

With regard to the word "International," however, it cannot be denied that definite boundaries have been set to the activities of IATA, perhaps due precisely to the Association's avowedly international aims.

It is possibly for this reason that Montreal, a city somewhat removed from the hub of world affairs, has been chosen as a suitable site for IATA's headquarters. This, it is hoped, will prove to be the golden mean. To have selected a location somewhere in New York might have laid IATA open to outside criticism as a tool of the predominant American airline industry. To have provided IATA with a seat somewhere in Europe would have been equally unsuitable, as it would have led the Americans to look on the Association as just another small-time European organization. Another cogent reason for choosing Montreal is that IATA is hardly separable in its workings from its supra-national opposite number, ICAO, and since the latter is now firmly anchored in the new International Aviation Building in Montreal, it is only logical that the city will remain—despite the wishes of several front- and back-bench members of the Association, who came out against the Montreal site for various reasons—the permanent headquarters of IATA. The Association recognised the weakness inherent in this arrangement and made an opportune move to strengthen its set-up by establishing Branch Offices with their corresponding permanent Traffic conferences in New York, Paris and Singapore. However, these Branch Offices can never be adequate substitutes for Headquarters, and the vital core of the organization remains in Montreal.

But let us probe this question as to whether IATA is really a worldwide association of economic interests, a co-operative service organisation, a little deeper.

IATA Executive Council, shown at the Fifth General Assembly of the Association at Scheveningen (The Hague) —presumably the sea breeze made for mental alertness. From left to right: John C. Leslie (PAA), Per A. Norlin (ABA), Sir William P. Hildred (IATA), Warren Lee Pierson (TWA), René Briend (Air France), Gilbert Périer (Sabena), Major J. Ronald McCrindle (BOAC), W. Hudson Fysh (Qantas), Roushdy Bey (Misrair), Dr. Albert Plesman (KLM), and Paolo Sampaio (Panair).

The Air Transport Association of America (ATA)

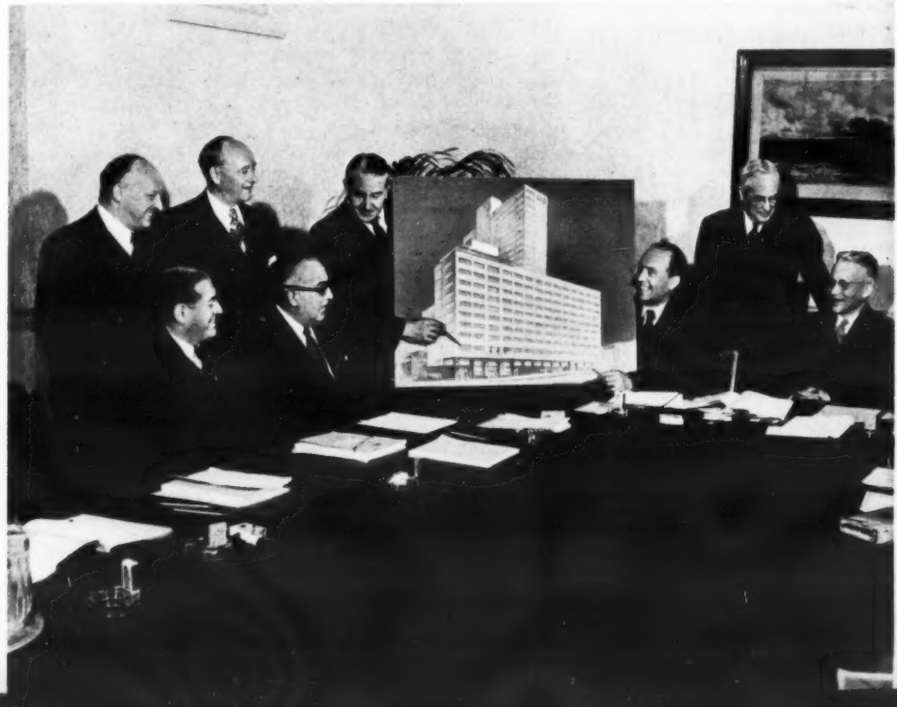
If one takes a walk along 16th Street in Washington, USA, you will find at No. 1107 an unpretentious building which houses another Air Transport Association, namely, the Air Transport Association of America (ATA). And in spite of its name, ATA is quite international in scope.

Founded in 1936—17 years after the birth of the pre-war European IATA and 9 years before the new world-wide IATA was to see the light—this association soon became an economically powerful organisation. At present it numbers 39 member companies, including 5 associated members from Canada, Central and South America. It is therefore Pan-American or, indeed, intercontinental in scope [1].

The top executive staff consists of four men, all U.S. citizens: Vice-Admiral Emory Scott Land, President, is a former Chief of the US Naval air service and at present a member of the Government's National Advisory Committee for Aeronautics and of other organizations; General Milton W. Arnold, Vice-President (Operations and Engineering), former Chief of Staff of the Military Air Transport Services, an engineer and meteorological

[1] The ATA's ordinary membership consists of 34 companies, viz: Alaska Airlines, All American Airways, Inc., American Airlines, Inc., American Overseas Airlines, Bonanza Air Lines, Inc., Braniff International Airways, Inc., Capital Airlines, Inc., Challenger Airlines, Co., Chicago & Southern Air Lines, Inc., Colonial Airlines, Inc., Continental Air Lines, Inc., Delta Air Lines, Inc., Eastern Air Lines, Inc., Empire Air Lines, Inc., Hawaiian Airlines, Ltd., Inland Air Lines, Inc., Mid-Continent Airlines, Inc., Monarch Air Lines, Inc., National Airlines, Inc., Northeast Airlines, Inc., Northwest Airlines, Inc., Pacific Northern Airlines, Pan American World Airways System. Piedmont Aviation, Inc., Pioneer Air Lines, Inc., Robinson Airlines Corp., Southern Airways, Inc., Southwest Airways Co., Trans Texas Airways, TWA—Trans World Airline, Turner Airlines, Inc., United Air Lines, Inc., Western Air Lines, Inc., Wisconsin Central Airlines, Inc.—At the beginning of 1950, *five airlines registered outside the USA* had also joined the ATA as *associated members*. These were: Canadian Pacific Air Lines, Ltd., Caribbean-Atlantic Airlines, Inc., Pan American—Grace Airways, Inc., Trans-Canada Air Lines, Trans-Pacific Airlines, Ltd.

Heads of IATA are seen here looking over plans for the new IATA headquarters building at Montreal, the International Aviation Building.



expert ; Executive Vice-President (in other words, Director-General) Robert Ramspeck is a one-time Congressman who had previously been a lawyer, a judge and a journalist. Head of the Legal Department is Stuart Guy Tipton, a former senior official of the US Civil Aeronautics Administration and an expert on economic affairs. These four men guide what is in effect a "co-operative non-profit service organisation." ("Air Affairs", Volume 3, No. 1.) According to the same source, ATA comprises eight main departments : Operations and Engineering, Air Navigation and Traffic Control, Traffic, Economic Research, Governmental Affairs, Finance and Accounting, Legal, and Public Relations. The Finance and Accounting Department has ten Standing Committees alone, and Special Committees are created to deal with any new and unusual problems which may crop up.

While IATA looks with pride on its Clearing House in London, the ATA can legitimately adopt a similar attitude with regard to its own establishment in Washington, through the offices of which settlements derived from US domestic traffic are made 25 days after the close of each month, while balance payments arising out of international traffic with 54 foreign airlines are settled in dollars 40 days after the ticket was handed across the counter.

However, the ATA does not boast of any ambitions of a global nature, but describes itself merely as a convenient link between individual members, the authorities and international organizations such as ICAO and IATA. The ATA, too, has its own branch offices, strategically situated at the focal points of American air traffic.

Aims of the ATA

With the intention of furthering the improvement of air transport in the US, ATA President Admiral Land in January, 1950, called for concentration of effort on six immediate aims, which parallel those of IATA very closely, namely improvement in operational safety and reliability, increased financial returns, and the provision of faster, more comfortable service for the airline passenger.

In April of this year, ATA Vice-President General Arnold made a statement about the results reached and the targets still to be achieved and it may be observed that none, or at best only a small part, of these aims have yet found their way into the pronouncements of IATA. They include an increase in operational revenue derived from first-class air traffice, the opening up of a new market through the introduction of second-class (air coach) transportation, expansion of the air cargo business and—in co-operation with IATA—improved operating regularity.

Now the American organization is fortunate in that, while it is not responsible for a world-wide network, it can look after a large-scale domestic network over long distances. Thus it has announced the following "operating figures" for US air transport during the current year : Revenue from regular domestic services will exceed $500,000,000, leaving a profit of at least $25,000,000 ; and operating

Vice-Admiral Emory Scott Land, Chairman of the ATA.

figures will surpass those for last year by a considerable margin, with an estimated 14,000,000 passengers carried on domestic routes, plus another 1,500,000 who will patronize US overseas services. Figures for freight and mail need not be considered here.

Economics to the Fore !

Compare the considerations from the eminent pen of the Director General of IATA, quoted at the beginning of this article, with ATA's performance, and you will discover the distinction between the European and American mentality. Hildred, the Briton, sees the task before him as that of assisting the cause of air transportation by unification and improvements in working methods, while the Americans outline their aims in terms of that ubiquitous standard, money... IATA busies itself with sending technical recommendations to ICAO, while ATA—as in the case of jet transports—can turn to its government for advice on technical questions. IATA is working towards a unified tariff system, and will shortly appoint new inspectors to see that it is enforced ; while in the case of the ATA, such a system is implicit, and any company that transgresses it is promptly ejected from the Association.

But these are only isolated instances, in considering which an important point has been overlooked, namely, that because of the manifold nationalities to which its members belong, of the widely varying political trends pursued by the respective governments, of language differences and other individual traits, IATA must needs tread warily if it is to retain its supra-national status. In contrast, the ATA, having no cause to be cautions, can come out bluntly in defence of its members, and takes up the cudgels in their favour against all comers, be they rail-, road-, or water-borne,

The Fight against Competition.

For—and this again is typically American—the ATA knows, as all its members know, that no-one is entirely without weapons with which to fight back, and that every victory must be fought for before it is won—and how the association does fight !

On opening up any US newspaper or magazine, one will as likely as not come across an advertisement which is in effect an appeal by the US railroads to the taxpaying citizen. The citizen will be told that the Government-subsidized airlines—for even American airlines get a state subsidy in the shape of mail pay—are being paid for out of his own pocket. He is also told that the government not only places shining specie at the airlines' disposal, but makes them a handsome present by allowing them to use airports and ground facilities almost free of charge. In contrast to all this profligate expenditure, the railways present a picture of honesty and careful husbandry, for they get no subsidy from the government—a matter which is open to discussion—and always pay scrupulously for everything they use.

And so, without having far to seek, one finds oneself already confronted with one of the fierce competitive struggles—for there are others— in which the ATA is currently mixed up.

In point of fact, Dr. Lewis C. Sorrell, who heads the ATA's Department of Economic Research on May 31st, 1950, described the situation as follows : First-Class rail traffic is on the downgrade in the US. In 1949, the revenue earned by 1st-Class railroad services (Pullman and sleeping cars) was only $397,000,000, whereas domestic trunk airlines earned $378,000,000 or almost as much as the railroads. Earnings of 2nd-class railroad services (coach services), made up predominantly by short-haul traffic, shrank to $488,000,000, due in large measure to stiff competition from inter-city bus lines, which grossed almost $400,000,000.

The ATA expert is thus in a position to prove to the rail-roads that the bus lines, not the airlines, are their most deadly foes. To make this clearer still, Dr. Sorrell quotes details from the fare policies practised by the various transportation groups :

1st-class Pullman fare
3.14 cents/mile (1.95 cents/km) ;
1st-class airline fare
5.76 cents/mile (3.60 cents/km).

Despite the higher rates charged, the airlines have been successful.

2nd-class rail coach fare
2.41 cents/mile (1.50 cents/km) ;
2nd-class air coach fare
4.00 cents/mile (2.05 cents/km).

This competition level is new, and results will only be available by 1951 at the earliest.

2nd-class rail coach fare
2.41 cents/mile (1.50 cents/km) ;
Inter-city bus fare
1.80 cents/mile (1.12 cents/km).

This competition can prove fatal to the railroads.

General Milton W. Arnold, Vice-President of the ATA.

To our Readers

What — yet another special issue, yet another double number of INTERAVIA REVIEW ?

Although our readers may feel a mild surprise as they learn of this latest bumper number of their favourite publication, we trust they will be well pleased with its contents ! Actually, your editors had several good reasons for deciding to embark on this course :

First of all, the calendar of forthcoming aviation events contains a feature of the first importance. In the middle of October, the foremost figures in worldwide civil air transportation will meet in San Francisco to attend the Sixth General Assembly of the International Air Transport Association, and the occasion is fraught with food for reflection, despite the cheery smiles on the faces of the delegates.

For the question as to whether international air transportation will ever really "make the grade" in its present set-up is gradually looming larger and larger on the horizon. When so serious a body as the Douglas Aircraft Co. can actually get up and say — as the result of a thorough and searching investigation — that of those sections of the American public who are potential travellers, more than half have never travelled by air, not even once, one can but raise one's eyebrows sky-high at this astonishing revelation of weakness, one might almost say of impotence. And this state of affairs is all the more lamentable when one considers that the American public is the most travelled and the most accessible in the world, while the U. S. airlines are the world's most progressive air transport companies. It is doubly humiliating if one goes on to consider what the results of a similar inquiry, undertaken in Europe, in South America, in South Africa or even in Asia would be ! And the group of international air transport experts assembled in San Francisco will have plenty of other problems to solve... Articles on some of them, and on IATA itself, will be found in these pages.

Another burning problem discussed in this special issue is the question — often-debated and much-publicized, but as yet not quite ripe — of the use of turbojet-powered aircraft in civil air transportation. The very complete data that we are giving about types and projects now under development will doubtless prove of interest to expert and tyro alike.

Finally, the political issues which are so much to the fore in the daily Press of the world have not been entirely left aside; thus our series on "Air Power Facing The Iron Curtain" is being rounded off by an article on the Air Forces of the Scandinavian States, two of which are members — and one almost so — of the Atlantic Pact. And to even matters up a little, we have also taken a prudent peep at what's going on behind that ominous piece of upholstery...

Such an abundance of material more than justifies the publication of a special double issue of INTERAVIA REVIEW !

To which it should also be added that in this way we shall be able to make sure that as from the end of this year INTERAVIA REVIEW will reach our subscribers — and the book-stores — regularly again at the beginning of each month.

INTERAVIA.

Robert Ramspeck, Executive Vice-President and Director-General of the ATA.

The Fight to protect Airline Interests

We trust we have made ourselves clear in our attempt to show, in the struggle between the railroads and the airlines, to what lengths an association representing a particular group of carriers will go in the US to defend the interests of its members. We could have gone on to paint a similar picture of the propaganda battle being waged between the airlines and the shipping companies, with respect to overseas routes, but we feel that one example of what we mean will be enough.

Now let us see what the Air Transport Association — speaking very broadly — has achieved for its members :

1) Since there are definite limits to the volume of traffic offering, the main part of the ATA's efforts has been successfully devoted to a deviation of a considerable part of overall revenue traffic volume in the United States from other transport media and into the hands of the airline operators.

2) Apart from this, new ground has been broken, and an entirely new class of traffic has been created, insofar as while only some ten years ago the total daily round traffic between the East and West Coasts amounted to not more than about 200 persons—for the rail trip took four days and nights, and cost several hundred dollars—traffic over the same stretch has now grown to several thousands daily in either direction, and the air journey between say New York and San Francisco takes only about 11 hours, and costs a mere 160 dollars.

3) The belief—which originated in Europe —that air transportation could only be run profitably with stage lengths greater than 300 miles has been resolutely set aside, with the result that thousands of people now travel by air daily on short routes such as that between New York and Washington (280 miles) or similar short routes on the West Coast.

4) But, above all, a sufficient reduction in air fares has been achieved to exorcise the myth that flying is and remains a luxury for the privileged few. Aviation in America has become a public utility in the full sense of the term, and caters for the community.

5) Going a step further in their efforts to cater for the 'man in the street', the US airlines are gradually introducing second-class air travel—the so-called "Air Coach System," which has not only dealt a telling blow at cut-price services run by wildcat companies, but is also proving highly competitive with second-class rail services and long-distance bus lines.

There is no room to dwell on the increases in mail and freight traffic, the struggle to lessen the tax burden, the improvements in shipping facilities, the standardization of statistical methods and other similar factors which have contributed to the present success.

Faced with all these achievements, there is no denying the fact that the US airlines have developed into an important and profitable branch of the national economy.

Thus one is led to ask oneself whether a global organization such as the International Air Transport Association can hope to produce similar results. We have seen that IATA is obliged to walk warily if it is to preserve its international character. For this reason alone, there are good grounds for doubting whether the organization is in a position to participate in a competitive struggle in individual traffic regions.

Let's Take a Look at Europe !

Hitherto, European transportation has been open to the airlines only to a very limited extent. A supra-national organization, which has its headquarters in another Continent, can expect to wield little influence, if any, in countries where the railways are State-owned and operated, and where the airlines are likewise dependent on State subsidies and are bound hand and foot by these considerations.

In Europe there is no opportunity whatsoever for the airlines to indulge in pioneering by opening up new classes of air transportation. Indeed—apart from a few tentative experiments—there has been no *general* move as yet to add night services to present timetables.

The affirmation that air transportation can only prove an economic proposition over long distances has been a convenient catch-phrase with which to avoid ruffling the feelings of the railway companies, who maintain an attitude of apparent friendliness towards the airlines.

Stuart Tipton, Head of the ATA Legal Committee.

Even though it may prove difficult to bring air tariffs on to a unified basis before the introduction of a European Payments Union, there is no overlooking the fact that, as a general rule, European air fares are much higher than US rates and in some cases more than *twice* as high. Thus, throughout the whole of Europe, air travel is still the exclusive prerogative of the well-to-do, and the airlines cannot be considered to be public utilities by any stretch of the imagination.

Under these conditions, no European company has yet made any attempt to introduce second-class air services on the Continent, since up to the present only the richest cream of the first-class market has been skimmed.

The facts speak for themselves, and we feel that we have made ourselves clear. And so we find ourselves inevitably led to draw up the following "Resolutions" and "Recommendations," which are a logical consequence of the situation, even though by doing so we shall run the risk of making ourselves unpopular in certain quarters. Like the Air Transport Association of America, we are trying to consider the problem in relation both to the customer's point of view and to the economic side of things.

The fact that a European Council is at present sitting in Strasbourg has given rise to many a dream of European unity, but in practice we are still far from achieving this ideal. Apparently we have to be satisfied with a state of affairs in which small groups of companies manage to achieve cooperation amongst themselves, whil others band themselves into opposing factions and still others prefer to remain aloof. Must we accept such conditions ? Why not attempt to clear up the mess, at least by setting up regional or continental cooperative service associations ? *We believe that the time has now come to found an Air Transport Association of Europe, and that no time should be lost in doing so.* And very likely the setting-up of such an institution would be followed very soon by the establishment of similar groups in other spheres of transportation . . .

IATA's Director-General, Sir William Hildred, would be wrong in thinking that regional groups of this type either would or could set themselves up in opposition to the great international association which he so successfully directs. In this respect, ATA can be quoted as a shining example. Many of its member airlines in the US are also faithful members of the IATA in Montreal . . . And we are convinced that, in view of the ever-increasing activity of world air transportation, IATA is a body which can no longer be dispensed with, if only for the regulation of competition in the North and South Atlantic and in the Pacific.

But IATA simply can never function as an organization taking care of regional or even continental interests. IATA is a world-wide organization, representing air transport interests throughout the world.

Pillars of World Air Transport - II

A "Who's Who" of the International Air Transport Association

The September, 1949, issue of this journal for the first time published a complete catalogue, brief historical summaries and tabulated information of all member airlines of the International Air Transport Association. This information is herewith revised and brought up to date on the occasion of the Sixth Annual General Meeting at San Francisco in October, 1950.

Numerically the membership in the Association has declined somewhat. A year ago there were seventy members, including sixty-four Active and six Associate Members. Today sixty-seven companies belong to the Association, including sixty-two Active and five Associate Members. The changes in IATA's membership were not confined to mere numbers, however. Six Active Members withdrew, namely, Air-India Ltd. ; British South American Airways (merged with BOAC) ; Eastern Air Lines, one of the four largest US operators (now an Associate Member) ; Hongkong Airways ; Indian National Airways ; and Skyways (East Africa) Ltd. *Active Members who have joined in the last year* are East African Airways ; Linee Aeree Italiane, the Italo-American company now operating on the North Atlantic run ; and National Airlines and Chicago & Southern Air Lines, two medium-size US operators engaging largely in domestic air transport but flying a few schedules to points outside the country. Two companies have left the list of Associate Members, namely, East African Airways, which has become an Active Member, and the Portuguese Companhia de Transportes Aeros. On the other hand, Eastern Air Lines has become an Associate Member, as stated above. While it was true last year that Associate Members engage in purely domestic flying, this no longer applies. Associate Members are marked by an asterisk (*).

As compared with last year, it is to be noted that certain trends towards consolidation have successfully asserted themselves. Pan American Airways has just been authorized to buy up American Overseas Airways, as a result of which the latter will also be eliminated from IATA in the near future ; British Overseas Airways Corporation has taken over British South American Airways Corp. ; in Italian air transportation a series of mergers has started and is continuing ; the member airlines of the Scandinavian Airline System may be formally merged some time in the coming year ; etc.

The IATA airlines no doubt continue to carry the lion's share of the international air traffic volume. In the field of domestic operations, the Air Transport Association of America still leads by a wide margin.

Details of IATA's members follow. As last year, three pages carry tables giving information on management, capitalization, air fleets and route mileage under the number assigned to each individual airline "case history."

Once again the Editors wish to point out that they have carefully sifted the material available for this compilation ; but they cannot fairly be held responsible for any gaps or inaccuracies that may have occurred.

1 B·O·A·C British Overseas Airways Corporation (BOAC)

Airways Terminal, Buckingham Palace Road, London, S.W.1.

BOAC was established on 24th November, 1939, under the British Overseas Airways Act, 1939. It began operations in 1940. The Act provided for the amalgamation of Imperial Airways, Ltd., and British Airways, Ltd., to form BOAC. Imperial Airways had been one of the chosen instruments for the operation of British international air services since it was founded on April 1st, 1924, by the merger of four earlier companies. The appointed day under the Act on which BOAC officially began operations was April 1st, 1940. During the war it operated under the control of the Secretary of State for Air and played an important role in the task of keeping open vital war-time communications. In 1949 British South American Airways Corporation, one of two new airline corporations created by the Civil Aviation Act of 1946 was merged with BOAC.

Principal routes : London to Middle and Far East, Australia, Africa, the Americas and the Caribbean.

Sir Miles Thomas, Chairman

2 BEA British European Airways Corporation (BEAC)

Keyline House, Northolt, Middx.

BEAC was formed on August 1st, 1946, from the British European Division of British Overseas Airways Corporation and nine private airlines to constitute the "chosen instrument" for air transport in the United Kingdom and within the Continent of Europe. In addition to services already operated by the former BOAC European Division, BEAC in the first year started regular schedules to Prague, Rome, Berlin, Ankara and other cities. The network has been further expanded since, and in the 1949-1950 year BEAC carried 751,512 passengers at a regularity of 97.1 %.

Principal routes : London, Birmingham and Manchester to 27 European stations ; internal routes serving about 30 stations.

Lord Douglas of Kirtleside, Chairman

3 Aer Lingus Teoranta

Upper O'Connell Street, Dublin.

Aer Lingus was founded in May, 1936, as the Irish national airline and started operations with a number of services to important centres in Britain. During the war years its activities were restricted to a route between Dublin, Liverpool and Manchester. When Shannon became a pivotal point in post-war trans-Atlantic air traffic and the world's first Custom-free airport, Aer Lingus assumed considerable importance as a feeder operator between the Irish Atlantic terminal and commercial centres in England and on the Continent. — Aer Lingus' parent company, Aer Rianta Teoranta, was also established in 1936, primarily to foster the general development of civil aviation in Ireland and to act as a holding company. It owns 60 percent of Aer Lingus and in turn is owned by the Irish Ministry of Finance ; 30 percent of Aer Lingus is held by British European Airways Corporation and 10 percent by British Overseas Airways Corp.

Principal routes : Shannon to Dublin and London ; Dublin to London, Liverpool, Birmingham, Glasgow, Manchester, Amsterdam, Paris, Isle of Man and Jersey (seasonal).

J. F. Dempsey, General Manager

Scandinavian Airlines System (SAS)

Bromma Airport, Stockholm.

Scandinavian Airlines System is the name given to the organization resulting from the unique operational coordination of the three Scandinavian air carriers, AB Aerotransport (Sweden), Det Norske Luftfahrtselskap (Norway) and Det Danske Luftfahrtselskab (Denmark). Before the war there had already been consultations between the Scandinavian countries with a view to establishing a jointly-operated airline to North America. However, the invasion of Norway and Denmark in 1940 thwarted these plans. Negotiations were resumed directly after the war and on August 1st, 1946, resulted in the formation of a consortium by the Danish DDL, the Norwegian DNL and the Swedish SILA airlines, who agreed to contribute to the operation of joint intercontinental air services in proportions amounting to two-sevenths, two-sevenths and three-sevenths for Denmark, Norway and Sweden, in that order. On July 1st, 1948, SILA was merged with ABA, the Swedish Government-controlled carrier which had operated Sweden's domestic and European services. A few weeks previously, it had been decided to extend SAS's cooperation also to the competitive European services hitherto operated separately by the three carriers, so that all Scandinavian international operations are now under the SAS flag. SAS now operates a fleet of about 70 aircraft to link 61 centres in 29 countries on four Continents. — Negotiations now pending between the interested Governments for the formal merger of the three SAS component airlines are to be continued in the late autumn of 1950.

Principal routes : European ; North Atlantic to New York ; South Atlantic to Buenos Aires ; Middle East ; East Africa and South Africa.

Details of SAS component companies follow :

4 AB Aerotransport (ABA)

Bromma Airport, Stockholm.

AB Aerotransport was founded on March 27th, 1924. At first ABA served only the principal cities in the neighbouring countries, but it soon reached out for London, Paris, Berlin and Amsterdam. At the outbreak of World War II in 1939, ABA had daily connections with all the main commercial centres in Europe. When Scandinavia became a theatre of war in 1940, civil aviation was also paralyzed in neutral Sweden. The country's sole air connection with the West was the blockade-running air service maintained by ABA and the Royal Air Force and, during the latter stages of the war, by USAAF Air Transport Command. Immediately after the end of the war in 1945, ABA inaugurated services to twelve European countries ; by 1947 this had grown to 19 countries and 26 cities, apart from an extensive domestic network serving nine Swedish cities.

In 1943 a new Swedish airline, SILA, was founded to operate Sweden's inter-continental air services. This company merged with ABA in July, 1948, and the resulting new ABA succeeded SILA as the Swedish partner in SAS. ABA is 50-percent State-owned.

Per A. Norlin, President

5 Det Norske Luftfartselskap A/S (DNL)

DNL 8 Fridtjof Nansens Plass, Oslo.

The first Norwegian airline, Det Norske Luftfartsrederei (DNL), was established in 1918 with a privately subscribed capital of Kr. 3,300,000. This company was succeeded in 1927 by Det Norske Luftfartselskap A/S which, however, did not start operations until the Norwegian shipping lines, Fred Olsen & Co. and Det Bergenske Dampskibsselskap, had invested Kr. 1,600,000 in 1935. In that year DDL obtained a ten-year concession from the Government to operate Norwegian domestic and international services. The company's activities were suppressed by the Germans during the war ; plans for the establishment of a new national airline under the same name were completed just after the war, and DNL began operations in April, 1946. It was formally incorporated three months later and in March, 1947, received a twenty-year concession to operate all principal domestic and international routes in, to and from Norway. Upon the formation of SAS in 1946, DNL became its Norwegian partner. The Norwegian Government holds just under 20 percent of DNL's capital.

Major-General Hjalmar Riiser-Larsen, President

6 Det Danske Luftfartselskab A/S (DDL)

Raadhuspladsen 59, Copenhagen.

DDL claims to be the world's oldest airline, since it was founded on October 29th, 1918, by Lieutenant Eckman and Willie Wulff, a businessman and sculptor. Its first regular routes, to Warnemunde and to Hamburg, were opened in 1920. — When the Germans occupied Denmark in 1940, all civil aviation was banned. DDL was later able to reopen a route to Vienna, via Berlin, and the routes to Malmoe and Ronne. These were both very valuable during the years when they constituted Denmark's only openings into the outer world. At the time of the German capitulation, DDL had only one aircraft immediately serviceable, and the personnel consisted of about 100. Plans had been made, however, for the revitalization of the company, and the administrative manager had gone to Sweden already during the occupation, via clandestine channels, to make the necessary contacts. Shortly after the cessation of hostilities DDL began to expand : In 1945 the company flew 33,000 aircraft miles (53,000 km), in 1948 222,000 miles (357,000 km). In August, 1946, DDL became the Danish partner in the Scandinavian cooperation between Norway, Sweden and Denmark under the name of SAS. Seventeen percent of DDL's capital is held by the Government, but recently there have been suggestions that the State should subscribe new capital, bringing its participation to about 40 percent.

Per Kampmann, President

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7 Aero O/Y (Finnish Airlines)

Mannerheimintie 9B, Helsinki.

Aero O/Y was founded on November 1st, 1923, and started its activities on March 20th of the following year by the inauguration of regular services between Helsinki and Tallinn. In the same year the Helsinki-Turku-Stockholm route was opened in cooperation with the newly founded Swedish AB Aerotransport. Other international services followed rapidly, and in 1937 the company began intensive domestic operations. During World War II aviation in Finland came under German domination, but Aero O/Y continued to share the Helsinki—Turku—Stockholm route with ABA. With the cessation of hostilities and in accordance with the Armistice agreement, the Company suspended its international operations. Permission to resume them was granted in November, 1947. Between 1924 and 1950, Aero O/Y increased its annual aircraft mileage from 10,520 miles (16,930 km) to 1,119,821 miles (1,801,792 km) and the Company is continuing to expand.—Aero O/Y represents the third attempt in Finland in the field of air transportation ; the two previous airlines, Suomen Ilmaliikenne O/Y and Lento O/Y, were founded and closed down in 1920. The line remained a completely private company until 1946, when the Finnish Government acquired control through the purchase of 70 percent of the company's stock.

Principal routes : Helsinki—Copenhagen—Amsterdam ; Helsinki—Stockholm ; Turku—Stockholm ; domestic services.

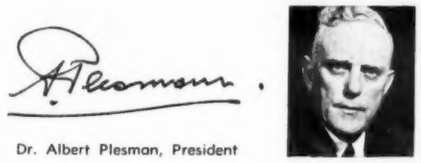
Lt.-Gen. Leonard Grandell, President

8 Koninklijke Luchtvaart Maatschappij N.V. (KLM—Royal Dutch Airlines)

Raamweg, The Hague.

A number of leading personalities of Dutch commercial, banking and industrial circles on October 17th, 1919, decided to found KLM Royal Dutch Airlines with a view to maintaining air services in and to the Netherlands and the overseas territories. Operations started in May of the following year, with a daily service between Amsterdam and London. By 1939—the outbreak of World War II—nearly every European city could be reached from Amsterdam in one day ; in addition, KLM had opened high-speed services to the Dutch East Indian possessions. This rapid progress was made possible first by the use of a variety of Fokker aircraft types, subsequently by KLM's introduction of the Douglas DC-2 and DC-3 transports in Europe. The outbreak of war first paralyzed a major part of KLM, and when the Netherlands also became involved in the hostilities, nearly the entire KLM fleet was destroyed or confiscated. With a few aircraft that had escaped, the company made an attempt to maintain operations abroad and flew them under charter to BOAC between London and Lisbon. Within one year after the liberation of the Netherlands, the entirely disrupted concern was completely rebuilt, and under the agressive leadership of Dr. Albert Plesman, KLM, the Netherlands' national airline, had become larger than ever. Old services have been restored, new ones opened to New York, Montreal, Caracas, Buenos Aires, Johannesburg, Teheran, Shanghai, etc. KLM to-day employs 13,000 people, including 1,300 aircrew, and operates to more than 100 cities.—The Netherlands Government is understood to hold a majority interest in KLM.

Principal routes : complete European network ; from Amsterdam to New York and Curaçao ; Montreal ; Central America ; South Africa ; Indonesia.



Dr. Albert Plesman, President

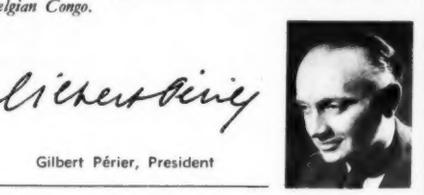
9 Société Anonyme Belge d'Exploitation de la Navigation Aérienne (SABENA)

145, Rue Royale, Brussels.

SABENA has been semi-Government owned since its foundation in 1923, when its initial capital of Belgian Frs. 6,000,000 was subscribed in equal proportions by Société Anonyme Belge pour l'Etude des Transports Aériens (SNETA) and the Belgian Government. During the first year of operations, SABENA was limited to the carriage of newspapers on the Brussels—Ostend—Lympne line. The first passenger service, Rotterdam—Brussels—Strasbourg—Basel, was inaugurated in 1924. Early in 1935 the Company started scheduled operations over its principal trunk line, the route between Belgium and the Belgian Congo. The war put a temporary stop to the activities of SABENA in Europe, but its organization in the Belgian Congo remained intact. SABENA's aircraft and personnel were used to supply the Allied forces in Africa and maintain essential air services.

Since the end of hostilities the company has resumed and expanded its pre-war operations. Its major new post-war service, the line from Brussels to New York, was inaugurated in August, 1946.

Principal routes : services linking 24 points in Europe ; to New York ; to Cairo ; to Lydda ; to the Belgian Congo ; to South-Africa ; plus a network of internal services in the Belgian Congo.



Gilbert Périer, President

10 Compagnie Belge de Transports Aériens (COBETA)

6, Rue du Midi, Brussels.

Cobeta was founded in London in 1943 by Marcel L.M. Dens, head of the Antwerp shipping firm of Armement Dens, who was in exile in London during the German occupation of Belgium. The Company opened scheduled services in July, 1947, from Brussels. There seems to be some connection with Scottish Aviation Ltd., from which Cobeta leases some of its aircraft.

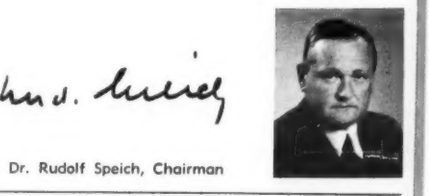
Principal routes : Brussels to Haifa ; Lydda ; Manchester ; Glasgow ; Lourdes, etc.

11 Swissair—Swiss Air Transport Company Ltd.

Hirschengraben 84, Zurich.

Swissair resulted from the merger of two local airlines, Ad-Astra and Balair, on March 26th, 1931. Under the management of two of the best-known Swiss civil aviation pioneers, Walter Mittelholzer and Balz Zimmermann, the company developed rapidly. Swissair was the first company to introduce in Europe, in 1932, two Lockheed "Orion" high-speed aircraft with retractable landing gear, which was an innovation in air transportation on the European Continent. World War II interrupted the line's development, but the end of the war found the company in better economic and operational shape than most of its European competitors. Soon it resumed some of its pre-war services : Geneva—Paris on July 30th, 1945, Zurich—Paris a few days later. In 1947 the Company became the national chosen instrument carrier, its capital was increased to Sw. frs. 20,000,000, and the Government and official bodies agreed to subscribe 30 percent of the total capitalization. Since that date Swissair has pursued its cautious expansion programme and has acquired new equipment for its European routes and the service to New York.

Principal routes : from Basle, Berne, Geneva and Zurich to sixteen capitals and seven other cities in Europe and the Middle East ; to New York.



Dr. Rudolf Speich, Chairman

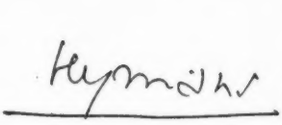
12 Compagnie Nationale Air France (Air France)

2, Rue Marbeuf, Paris, VIII^e.

The history of Air France can be divided into four stages : 1918 to 1933 : This was the pioneering period in which a number of Air France predecessor companies established air services to points in Western and Eastern Europe, to the Middle and Far East and South America. 1933-1939 : The beginning of this stage was marked by the formation of Air France through the consolidation of six predecessor airlines. It was a period of expansion and experimentation and also witnessed the development of other lines which finally became absorbed in Air France : Régie Air Afrique, Régie Malgache, Compagnie Air Bleu, Compagnie Aéromaritime, and Air France Transatlantique, the last-named of which made twelve North Atlantic proving flights before the outbreak of war. 1939-1945 : Upon the outbreak of war, Air France's personnel and equipment was placed at the disposal of the Government. After the Franco-German armistice, from 1940 to 1942, several regular services were flown between unoccupied France and points in North and West Africa. In 1942, personnel and equipment that had escaped the Germans were reorganized in North Africa and operated three networks of military routes known as "Lignes Aériennes Militaires" (LAM). Directly after the Liberation, the remnants of Air France's personnel and equipment at home were formed into a fourth military network, and early in 1945 the four systems (Metropolitan France, North Africa, Central Africa, and Near East) were placed under a centralized command, the "Réseau des Lignes

Aériennes Françaises," which in effect constituted the nucleus of the new Air France. 1946-1949 : In January, 1946, the name of Air France was officially re-established. On June 16th, 1948, the provisional status of Air France was abolished and replaced by law with its present constitution as Compagnie Nationale Air France, the French Government's (85-percent owned) "chosen instrument" air carrier.

Principal routes : Intercontinental routes to North and South America, West Africa, Madagascar, Pakistan, India (and French Indo-China) ; European routes from Paris and other French cities to 16 centres ; Mediterranean routes ; Central African ; Central American local routes ; local routes in Madagascar ; Far Eastern local routes ; domestic routes.



Dr. Max Hymans, Chairman

13 Iberia—Compania Mercantil de Lineas Aereas Espanolas S.A.

Plaza de Canovas del Castillo 4, Madrid.

The new Iberia is the indirect successor to three Spanish air carriers established in 1921-22, namely, Iberia Compania Aerea de Transportes, Compania Espanola de Trafico Aereo, and Union Aerea Espanola. In 1929 the three were amalgamated into a new company, subsidized by the Spanish Government and backed by Spanish private finance and industry : Cia Concesionaria de Lineas Aereas Subvencionadas S.A. (CLASSA). This organisation was in turn succeeded in 1932 by a State-controlled commercial organization, Lineas Aereas Postales Espanolas (LAPE). When the Civil War broke out in Spain in 1936, LAPE remained in the hands of the Republicans and its services became disrupted. The Falangists, on the other hand, organized air services in their own territory with German assistance, and Sociedad Espanola Iberia was established in 1937 to carry on air transport operations. However, when the Civil War ended in 1939, Spanish civil aviation had ceased to exist. In order to relieve pressure on the remaining meagre surface transport, the Government in April, 1940, set up a temporary Commission (Trafico Aereo Espanol) to operate civil air services. A few months later the new Iberia was formed to take over the assets of the old LAPE and the wartime Iberia. Capitalization was Ptas. 12,000,000, 51% of which was held by the Government, 24.5% by Spanish private individuals and 24.5% by Deutsche Lufthansa (against the supply of equipment, etc.). The two minority holdings were acquired by the Instituto Nacional de Industria in 1941, and today the increased capital (Ptas. 35,400,000) is 100-percent Government-owned. However, the civil airlines act of 1940 authorizes 49 percent of the capitalization to be held by private interests.

Principal routes : from Madrid to London ; Paris ; Geneva ; Rome ; Lisbon ; Havana ; Buenos Aires ; Mexico City ; North and West Africa ; domestic services ; etc.

Cesar Gomez Lucia, Managing Director

14 Transportes Aereos Portugueses (TAP)

Rua Braancamp 2, Lisboa.

The Portuguese Government established Transportes Aereos Portugueses in the middle of 1944 as a Division of the Secretariat of Civil Aviation. The Division operated experimentally until September, 1946, when regular schedules were inaugurated. TAP's initial object was to undertake proving and survey flights on new routes which subsequently were to be transferred to commercial airlines for scheduled operation. No route transfers have so far taken place, however. TAP's most important operation is that connecting the mother country with two African Colonies, on the west coast : San Tomé on the Island of San Tomé and Luanda in Angola.

Principal routes : Lisbon—San Tomé—Luanda ; Lisbon—London ; Lisbon—Paris ; Lisbon—Madrid ; Lisbon—Porto.

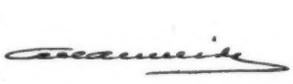
Col. Carlos M. Magalhaes, General Manager

15 Aero Portuguesa Lda. (Aero—Portugueral)

Avenida da Liberdade 120, Lisboa.

Aero Portuguesa Lda. was organized in 1934 as a subsidiary of Air France. Its main object was the establishment of a route from Lisbon to Casablanca, connecting there with Air France's South Atlantic air mail service. Operations started in October, 1934, and continued until the outbreak of war, when the line had to be temporarily terminated at Tangiers. In 1943 the Portuguese Government issued a requirement that at least 62.5 percent of the Company's capital be held by Portuguese interests, whereupon Air France sold half of its 75 percent holding to Companhia Nacional de Navegacao, the shipping concern, bringing the Portuguese holding to the required figures ; in September, 1948, Air France sold the balance of its interest in Aero Portuguesa. In 1946 the Company had opened unsuccessful negotiations for a service to Paris, and at present Aero Portuguesa awaits the formulation of a policy by Prime Minister Salazar regarding the designation of a colonial or international air carrier.

Principal route : Lisbon—Tangier.



Antonio de Medeiros e Almeido, President

16 Alitalia—Aerolinee Italiane Internazionali

Via L. Bissolati, 20, Rome.

Alitalia was established in September of 1946, under an agreement between the Government-owned Institute per la Ricostruzione Industriale and the British Overseas Airways Corporation. The initial capital of Lire 900,000,000 was held to the extent of 40% each by BOAC and IRI, whereas 20% was left to Italian private industry. In 1948 it was proposed to increase the capital to Lire 2,500,000,000, but the plan failed due to opposition by the British Treasury. The capitalization was later raised to Lire 1,500,000,000, however, with the proportions of ownership remaining unchanged and subsequently to 2,000,000,000, as a result of which the proportion of the British holding declined to 29 percent. BOAC has meanwhile been succeeded by British European Airways Corp. as the British stockholder in the company. Alitalia was the first and only Italian airline to resume operations to South America when, in May, 1948, it opened its service to Buenos Aires. As a result of its recent merger with the State-owned LATI airline (Linee Aeree Transcontinentali Italiane), Alitalia now also operates a weekly service to Central America. At the present time the company is preparing new routes to South Africa, Kenya, to the Near and Far East and to Northern Europe.

Principal routes : from Rome to Natal, Rio de Janeiro, Sao Paulo, Montevideo and Buenos Aires ; to Venezuela ; to Cairo, Asmara and Mogadishu ; to Paris ; to London ; etc.

Count Nicolo Carandini, Chairman

17 ALI Flotte Riunite

Via L. Bissolati, 76, Rome.

ALI Flotte Riunite's predecessor, Avio Linee Italiane, was established in November, 1926. The original capital of Lire 12,000,000 was subscribed by the Fiat industrial concern, Standard Oil interests and the Government. The Company opened its post-war operations in 1946 and gradually extended its services. The highly competitive situation in Italian air transport made the desirability of consolidation increasingly evident, and negotiations to this end were started with several other Italian carriers in 1948. Last July these led to the formation of ALI Flotte Riunite through the merger of Avio Linee Italiane with Aerone, SISA and Transadriatica, as the first stage of a vast consolidation plan. A majority interest in the new company continues to be held by Fiat.

Principal routes : Rome to Vienna, Prague, Athens, Beirut, Barcelona ; from Milan to Paris, Brussels, Amsterdam, Frankfurt, Nice, Barcelona ; domestic services.

Dr. U. G. Ringler, President

18 LAI Linee Aeree Italiane S.A. (LAI)

Via del Tritone, 132, Rome.

LAI was formed on September 16th, 1946, with a capitalization of Lire 10,000,000 which subsequently was increased to Lire 200,000,000. A 60-percent interest is held by the Italian Government and by Italian private investors, whereas the balance of 40 percent is owned by Trans World Airline, the big US carrier. Regular services were started in April, 1947, and in the remaining months of that year the company covered 1,430,183 aircraft kilometres ; this rose to 3,162,484 kilometres in 1948 and 3,819,284 kilometres in 1949. Early in 1950 LAI was awarded the bitterly disputed Rome—New York route certificate and recently started regular operations with Douglas DC-6 equipment.

Principal routes : 14 routes linking Italy with Canada, Egypt, Eire, Israel, Greece, Tunisia, Turkey and USA.

Prince Marcantonio Pacelli, Chairman of the Board

19 TAE Greek Airlines (TAE)—Technical & Aeronautical Exploitation Co. Ltd.

12, Merlin Street, Athens.

Greek Airlines (TAE), the first post-war Greek airline, was originally established in 1940—before the German occupation—as an air charter and taxi company by Colonel Stephen A. Zotos, present Managing Director. Its equipment and installations were destroyed by the management to prevent them from falling into German hands. In 1946 Greek Airlines signed a contract with Trans World Airline, under which TWA. subscribed 35 percent of the Company's new, privately-owned capital and provided it with technical assistance. Greek Airlines is one of the most intensively operated small carriers : in 1949 it flew 2,349,751 aircraft miles over a network totalling 2,627 route miles. The company is planning new services to Istanbul, Rome and Paris.

Principal routes : Athens to Alexandria, Istanbul, Rhodes, Crete ; 22 domestic routes.

Col. Stephen A. Zotos, Managing Director

20 Hellenic Airlines S.A. ("Hellas")

St. George Karyoti Square, Athens.

"Hellas" is the result of an agreement signed in November, 1947, between Scottish Aviation Ltd., British charter company, maintenance and manufacturing organization, and the Pension Funds of the Greek Army, Navy, Air Force and Civil Service. The agreement provided for the establishment of an airline operating Greek internal and overseas air services, the intention being that "Hellas" should become the Greek "chosen instrument" airline. Scottish Aviation furnished 40 percent of the capital as well as technical assistance and leased the necessary equipment to "Hellas". In addition to its present routes, "Hellas" is planning services to Cyprus and points in Italy, Switzerland and France, apart from Paris.

Principal routes : Prestwick—London—Paris—Athens—Nicosia—Lydda ; Athens to Paris and Glasgow ; to Alexandria ; domestic services to about 10 stations.

J. Sakellion, President

21 CSA Ceskolovenske Aerolinie (CSA)—Czechoslovak Airlines

1, Namestie Republiky, Prague.

Ceskoslovenske Aerolinie celebrated its 25th anniversary on March 1st, 1948. It was in 1923 that an aircraft of its predecessor airline, Ceskoslovenske Statni Aerolinie (CSA), made the first flight from Prague to Bratislava. The old CSA successfully competed with a second Czech line, Ceskoslovenske Letecka Spolecnost (CLS), founded in 1927, for its position as Czech flag air carrier. Both companies ceased operations after the German occupation in March, 1939. After the end of the war in 1945, the two airlines were merged into the present CSA which is a direct State enterprise within the Civil Aviation Department of the Ministry of Transport. Plans have been worked out to reorganize CSA as a corporation similar to the State corporations set up in other branches of national economy.—CSA's expansion plans were severely handicapped following the Communist seizure of power early in 1948. The Company had been negotiating for a number of Lockheed "Constellations," Douglas DC-4s, or "Canadair-Fours," but the suppliers refused to sign a contract as a result of the political events in Prague. CSA thereupon turned to the USSR, which meanwhile has delivered four Ilyushin IL-12 twin-engined airliners and promised delivery of several Ilyushin IL-18 four-engined aircraft. CSA's plans include services to India, South Africa, etc.

Principal routes : Prague to Budapest, Belgrade, Sofia, Bucharest ; Rome, Athens, Lydda, Istanbul, Zurich, Paris, London, Copenhagen, Stockholm, Oslo, Berlin, Warsaw, etc. ; domestic services.

22 LOT Polskie Linie Lotnicze (LOT)

Rue Hoza 39, Warsaw.

LOT was another result of the tendency in the 'Twenties to consolidate smaller airlines into single national flag carriers. The Company was founded on January 1st, 1929, by the amalgamation of two private Polish lines, Aerolot and Aero ; its initial capital of Zl. 8,000,000 was held by the Finance Ministry and other public bodies. LOT was one of the first European companies to put the Douglas DC-2 and Lockheed 14 transports into service. — LOT resumed its services under a decree of March 6th, 1945, which placed the concern under direct State control. Its flying equipment consists of five French-built "Languedoc" airliners, about 26 Li-2 transports (Russian-built DC-3s) and a few Douglas DC-3s, plus a number of modern Ilyushin IL-12 twin-engined airliners purchased in Russia. LOT flies about 200 services weekly and in 1948 aggregated 2,363,212 aircraft kilometres with a total of 77,552 passengers.

Principal routes : Warsaw to Stockholm, Copenhagen, Berlin, Paris, Brussels, Prague, Budapest, Sofia, Bucharest, Istanbul ; domestic services.

American & Canadian Airlines

23 Pan American Airways, Inc. (PAA)

135, East 42nd St., New York 17, N. Y.

Pan American Airways will be 23 years of age at the time of the San Francisco meeting of IATA, namely, on October 19th. Although younger than many other world-wide airline systems, it is the largest international air carrier in the world to-day. It made its first flight on October 19th, 1927, carrying a 500-lb. load of international mail over the 90-mile stretch from Key West, Florida, to Havana, and throughout its subsequent history it has engaged only in international operations. The company was a result of the amalgamation of three small lines, Aviation Corporation of the Americas, Florida Airways and Pan American Airways Inc. In the first years of its existence it concentrated on the establishment of air services to points in Central and South America. Soon the management discovered that it was to its advantage in certain parts of the world to operate through so-called "national affiliates," *i. e.*, companies which are nominally registered in the countries of their domicile but are financially or operationally controlled or "inspired" by PAA. At the present time PAA possesses interests in the following major airlines : Panair do Brasil, Aerovias Nacionales de Colombia (AVIANCA), Compania Mexicana de Aviacion, Compania Cubana de Aviacion, China National Aviation Corporation ; it also holds a 50 % interest in Pan American-Grace Airways, which operates services along the west coast of South America. Investments in smaller companies include Aeronaves de Mexico, Aerovias Venezolanas S. A., Bahamas Airways, Compania Dominicana de Aviacion, Compania Panamena de Aviacion, Lineas Aeras de Nicaragua, Servicio Aereo de Honduras, Lineas Aereas Costaricenses.

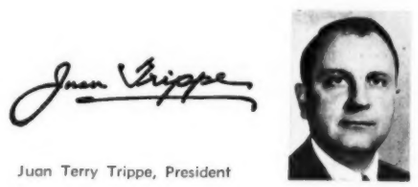
In 1935 PAA opened trans-Pacific passenger services to Hong Kong ; a route to New Zealand was added in 1940. PAA had extended its activities to the North Atlantic already in 1938 and since the end of the War it has expanded its East-bound operations as far as Calcutta. There it linked up with its Pacific services, and PAA thus became the first airline to establish round-the-world services (excepting the continental USA).

During World War II PAA's network of air routes was controlled by the US Government but the Company continued to operate under contract to the authorities.

Another outstanding characteristic of PAA is the fact that even in times of serious financial difficulties in the airline industry, it has consistently succeeded in making money.

Last July the CAB—reversing an originally unfavourable decision—approved the purchase by PAA of American Overseas Airlines for $17,450,000. This victory, the result of an extremely embittered struggle, will immeasurably strengthen PAA's already dominant competitive situation and enable the company to add services to the North of Europe, Frankfurt and Berlin, Paris, Rome and the Near East to its existing routes. General Harold R. Harris, Vice-President and General Manager of AOA, will join PAA to head the latter's much expanded North Atlantic operations.

Principal routes : Atlantic : to London, Central Europe, Middle East and Karachi, Calcutta, linking with Pacific services. New York to Lisbon, Madrid ; to Dakar and Johannesburg.
To be inaugurated shortly : to Oslo, Copenhagen, Stockholm, Frankfurt, Berlin, Paris, Rome, Near East.
Latin America : complete network to Central and South America.
Pacific : Seattle, San Francisco and Los Angeles to Honolulu, New Zealand and Australia ; to Tokyo, Hong Kong, Philippines, Siam and Batavia, etc.



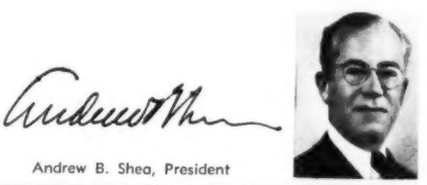
Juan Terry Trippe, President

24 Pan American—Grace Airways, Inc. (Panagra)

135, East 42nd Street, New York 17, N. Y.

Panagra's predecessor was formed on September 13th, 1928, by Pan American Airways and W. R. Grace & Co., the US shipping concern ; PAA and Grace jointly bought up Huff-Daland, Inc., a general airwork company, and renamed it Peruvian Airways Corp. Operations started almost at once under a Peruvian Government air transport concession. The company's name was changed to Pan American-Grace Airways early in 1929, and within one year Panagra had extended its services to Santiago, Buenos Aires and Montevideo. To-day Panagra forms an important link in the network of airlines operated by Pan American Airways. — During the war Panagra worked under contract to USAAF. Air Transport Command and was instrumental in ousting German-held interests from civil aviation in several South American countries. — Relations between Panagra's owners have not always been rosy. In 1943 both PAA and Grace declared before the CAB that the other party was deliberately "retarding" the progress of the Company in order to obtain full control. These difficulties seem to have been partly overcome in the meantime, however. — From 1939 to recently, Harold J. Roig has been Panagra's President. In July, 1949, he was succeeded by Andrew B. Shea, Director and Senior Vice-President of W. R. Grace & Co. Douglas Campbell is General Manager.

Principal routes : Miami—Balboa—Guayaquil—Lima—Santiago—Buenos Aires—Montevideo ; other services in Colombia, Ecuador, Peru, Bolivia, Chile, Argentina.



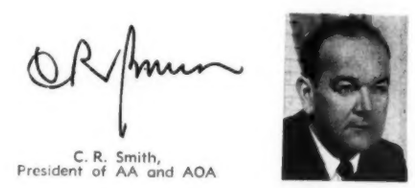
Andrew B. Shea, President

25 American Airlines, Inc. (AA)

100, East 42nd St., New York 17, N. Y.

American Airways, Inc., was formed on January 25th, 1930, by the consolidation of Colonial Airways, Universal Aviation Corp., Southern Air Transport System, Interstate Airlines, Thompson Aeronautical Corp., Embry-Riddle Co., Frank Mortz Airlines, Century Airlines and Century Pacific Air Lines. The Company was reorganized after the air mail contract cancellations of 1934 and renamed American Airlines. Highlights in the evolution of American Airlines were the inauguration of the first sleeper aircraft service in 1934 and the introduction of the Douglas DC-2 in the same year. In 1935 AA developed an airways traffic control system which was later adopted by all airlines and administered by the Civil Aeronautics Administration. In collaboration with Radio Corporation of America, AA pioneered the development of UHF radio for two-way communications. After America's entry into the war the company turned over 38 of its 84 aircraft to the Army Air Forces. Throughout the war American Airlines also conducted contract flights, training and engineering operations for the Allied forces. Immediately after the cessation of hostilities in Europe, in July, 1945, American bought a majority interest in American Export Airlines, which was renamed American Overseas Airlines. American Airlines last July was authorized to sell AOA to Pan American Airways, as a result of which its own financial strength will be strengthened.

Principal routes : American Airlines operates the largest network of US domestic services, including transcontinental services from East Coast cities (Boston, New York, Philadelphia, Washington) Chicago and Detroit, to San Francisco and Los Angeles. It also flies to Canada in the north and Mexico City in the south.



C. R. Smith,
President of AA and AOA

26 American Overseas Airlines (AOA)

100, East 42nd St., New York 17, N. Y.

American Overseas Airlines is the successor to American Export Airlines which was incorporated in 1937 as a subsidiary of American Export Lines, the shipping firm, to operate trans-Atlantic air services in conjunction with the parent company's steamship operations. American Export Airlines started operations in 1942. The Civil Aeronautics Board subsequently ordered the airlines to devest itself of steamship control, and on July 5th, 1945, the Board approved the purchase of a majority interest in AEA by American Airlines and, thus, the integration of AEA's trans-Atlantic services with the domestic services of AA. In November of the same year AEA changed its name to American Overseas Airlines. The company is about to be taken over by Pan American Airways under the CAB decision announced at President Truman's instigation last July.

27 Trans World Airlines, Inc.

630, Fifth Avenue, New York 20, N. Y. — 101, West 11th St., Kansas City 6, Mo.

When TWA, early in 1950, changed its corporate name from Transcontinental & Western Air, Inc., to Trans World Airlines, Inc., the change reflected the great expansion of the company into a globe-circling service whose red "TWA" insignia is a familiar sight in cities half-way around the world. The USA's oldest transcontinental airline, TWA has been offering the public a scheduled air service since 1929, and October, 1950, marks the 20th anniversary of Coast-to-Coast all-air service. TWA's predecessor companies were Western Air Express, organized in 1925, Aero Corporation of California, formed in 1926 and changed to Standard Air Lines in 1927, Maddux Air Lines, formed in 1926 and its most immediate predecessor, Transcontinental Air Transport, known as TAT, formed in 1928. As a result of mergers of these air services, TWA was born on October 1st, 1930, and 25 days later began all-air coast-to-coast service of 36 hours.

After global experience gained in its operations during the war for the Air Transport Command of the United States Army Air Forces, TWA early in 1946 began service on its trans-Atlantic and international routes. Certificated as far as Shanghai, TWA at present flies only that portion of its route through the British Isles, Continental Europe, North Africa and the Middle East as far as Bombay, India.

TWA was one of the most resolute opponents of the PAA-AOA merger recently approved by the CAB, which greatly strengthened the North Atlantic position of PAA, TWA's major competitor. In return, TWA received the right to fly to London, Germany and the Scandinavian countries.

Principal routes : USA : transcontinental, from East Coast cities to Los Angeles and San Francisco via Pittsburgh, Chicago, Kansas City, St. Louis, Albuquerque, Phœnix and intermediate cities. Trans-Atlantic routes from the USA to Ireland, London, Paris, Geneva, Zurich, Frankfurt, also via Lisbon and Madrid to Rome, Athens, Tunis, Algiers, Cairo, Israel, Dhahran, Basra and Bombay.

Ralph S. Damon, President

28 United Air Lines (UAL)

5959 South Cicero Avenue, Clearing Station, Chicago 38, Ill.

UAL's first two predecessor companies, Varney Air Lines and Pacific Air Transport, began services in the western part of the USA in 1926. In 1927, Boeing Air Transport and National Air Transport, the other two predecessors, started operations between San Francisco and Chicago, on the one hand, and Chicago and New York on the other. The four companies were merged to form United Air Lines in 1931. Upon America's entry into World War II, half of UAL's fleet of twin-engined transports were turned over to the US Army Air Forces. During the next three years, UAL crews flew for the Air Transport Command across the Pacific as well as between the USA and Alaska. After the war, the Company was granted a certificate to operate services between San Francisco and Honolulu.

United's wartime activities included the modification of 5,736 military aircraft and the training of hundreds of military ground and flight personnel. "Firsts" introduced by United and its predecessors were the employment of air hostesses in 1930, the adoption of all-metal low-wing twin-engined transports (the Boeing 247) in 1933, first tests of instrument landing procedures in 1932.

At the end of 1949, UAL and its predecessors had flown a cumulative total of 13,194,000 passengers and 7,000,000,000 revenue passenger miles.

Principal routes : transcontinental, from Boston, New York, Philadelphia, Washington, Detroit, Cleveland and Chicago to San Francisco and Los Angeles ; American West Coast from Vancouver to Seattle, Portland, San Francisco, Los Angeles and San Diego ; San Francisco and Los Angeles to Honolulu. Routes of LAMSA, United's Mexican subsidiary, extend 2,000 miles from the US-Mexican border to Mexico City.

W. A. Patterson, President

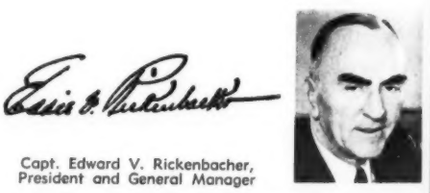
29 Eastern Air Lines (EAL)

Eastern Air Lines Building, 10, Rockefeller Plaza, New York 20, N. Y.

Eastern Air Lines, one of the four largest US domestic airlines, in 1934 succeeded Pitcairn Aviation Inc. ; the latter had been formed in 1928 for the carriage of mail between New York and Atlanta. Originally, Eastern was a division of North American Aviation, Inc., the manufacturing firm which in turn was controlled by General Motors Corp. In 1938 Captain Edward Vernon Rickenbacker, America's World War I air ace, and a number of associates, bought the line from General Motors for $3,500,000 and changed its name to Eastern Air Lines, Inc.

The most characteristic feature of EAL has been the fact that it has been consistently profitable for the past fifteen years. To finance his conservative equipment programme, Rickenbacker obtained at the end of 1946 a five-year loan of $20,000,000 from 27 banks at an interest rate of only 1 ½ percent ; $16,000,000 of the loan has so far been used. — EAL did not engage in any large-scale foreign route expansion programme directly after the war, but its present plans are fairly extensive : apart from its ambition to become the fifth US transcontinental operator by inaugurating the Southern Transcontinental Route from Miami to New Orleans, San Antonio (Tex.), El Paso, San Diego, Los Angeles and San Francisco, it has applied to the CAB for permission to operate non-stop services from New York and Washington to Puerto Rico. It has also asked for authorization to open new services to about 35 stations in the northeast of the USA and Canada.

Principal routes : New York—Washington—New Orleans—Mexico City ; Miami—San Juan (P.R.) ; a vast network of domestic routes in the eastern USA linking about 80 stations.



Capt. Edward V. Rickenbacher,
President and General Manager

30 Northwest Airlines, Inc.

1885, University Avenue, St. Paul, Minnesota.

Northwest Airlines' predecessor company, Northwest Airways, began operations in the autumn of 1926 with a regular air mail service between the Twin Cities (Minneapolis and St. Paul) and Chicago. In 1927 the company inaugurated passenger services and also extended its operations across the border to Winnipeg, Canada. In 1941 the company applied for permission to fly to Alaska, but America entered the war shortly afterwards and no civil air route was opened. On the other hand, Northwest personnel was hired by the Air Force with a view to establishing a military air supply line for the US forces fighting the Japanese in the Aleutians. Later in the war the company operated bomber modification centres at St. Paul and Vandalia, and ran several Army and Air Force training schools. Directly after the end of the war in Europe, Northwest opened services from the Twin Cities to New York and thus became the fourth US transcontinental operator. Meanwhile, Northwest had made preparations to branch out into the international air transport field, and in the middle of 1947 it began operations to Tokyo, Shanghai and Manila. Since then, the Company has further expanded its network and started a service to Honolulu, Hawaii, in December 1948.

Principal routes : transcontinental from New York to Seattle ; Seattle—Honolulu ; North Pacific service from New York to Alaska, the Aleutians, Japan, Korea (temporarily suspended), China and the Philippines.

Croil Hunter,
President and General Manager

31 Braniff Airways, Inc.

Love Field, Dallas, Texas.

Thomas Braniff formed his first Braniff Airways in 1928 to operate service in Oklahoma, Kansas and Missouri ; he lost money and the following year sold out to another line. In 1930 Braniff saw the possibility of obtaining US mail contracts and registered Braniff Airways Inc. for services in the Oklahoma—Kansas—Texas area. Although the Company did not receive the contracts it had expected, it expanded steadily. The fact that during the war it operated services to the Panama Canal Zone under contract to the US Army seems to have given it a taste for international operations. It set up a Mexican subsidiary, Aerovias Braniff S.A., which to-day has a capital of 20,000,000 Pesos (51 percent owned by Mexican interests, 49 percent by Thomas E. Braniff ; in 1946 CAB rejected a Braniff Airways application to re-acquire control of its former subsidiary). In 1946 the CAB granted Braniff permission to fly more than 7,000 route-miles of services from Houston, Tex., along the South American Pacific Coast to Quito, Guayaquil and across the Andes to Rio and Buenos Aires. Following difficult negotiations with the South American authorities, Braniff inaugurated the service last year and now operates as far as Buenos Aires. The Company has applied to the CAB for permission to fly south to Santiago de Chile and north to Washington and New York.

Principal routes : Houston—Havana—Balboa—Guayaquil—Lima—La Paz—Rio de Janeiro—Buenos Aires ; domestic services in the central US and Texas.

Thomas E. Braniff, President

32 Chicago & Southern Air Lines, Inc.

Memphis Municipal Airport, Memphis 2, Tenn.

Chicago & Southern Air Lines, Inc., had its origin in the formation in June, 1933, of Pacific Seaboard Air Lines, Inc., a California operator, which ran a passenger and express air service within the State of California, without a mail contract, between San Francisco and Los Angeles. In 1934, Pacific Seaboard Air Lines was awarded a mail contract between Chicago, Ill., and New Orleans, La., and moved its operations, personnel and equipment to the territory involved in the contract. In December of the same year, by reason of the change in the territory served, the name was changed to Chicago and Southern Air Lines, Inc. On December 31st, 1935, the assets and business of C&SAL were acquired by the present company of the same name, which was incorporated under the laws of the State of Delaware on December 30th, 1935. The principal office of the company was moved from St. Louis to Memphis in 1941.

Principal routes : Chicago to New Orleans via St. Louis, Memphis, Greenwood and Jackson ; Chicago to Evansville ; Detroit to Houston ; New Orleans and Houston to Caracas, via Havana and Kingston, Jamaica.

Carleton Putnam, Chairman

33 National Airlines, Inc.

Aviation Building, 3240 NW 27th Avenue, Miami 37, Fla.

National Airlines was established in 1937 by G. T. Baker, President. The first operation was on a route between St. Petersburgh and Daytona Beach, Fla., a distance of 292 miles. At present the company has 1,750 employees and operates on 2,730 unduplicated route miles, notably along the US East Coast and in the south of the country. In 1946 the company was the victim of a prolonged pilots' strike but continued operations by the employment of non-union pilots. As a result of the strike, the CAB at one time considered allocating National's routes to other carriers, but this plan was later dropped. Industry observers believe that National may consolidate its position by merging with other smaller US carriers, notably Delta Air Lines. In May, 1949, National granted options to W. R. Grace & Company, the shipping line and co-owner of Pan American-Grace Airways, and to Pan American Airways for the purchase of 220,000 shares and 370,000 shres, respectively, which would grant the two concerns a combined interest in National of about 27 percent. These options must be exercised prior to December 31st, 1952.

Principal routes : New York to Miami, Fla., via Philadelphia, etc, ; Jacksonville to Miami ; Jacksonville to New Orleans ; Miami to Havana, Cuba, and Tampa to Havana.

34 Trans-Canada Air Lines (TCA)

International Aviation Building, 1080, University Street, Montreal, Quebec, Canada.

Trans-Canada Air Lines was incorporated by Act of Parliament on April 10th, 1937, as an autonomous Government-owned corporation. The Canadian National Railways, itself an autonomous public-owned corporation, holds the capital stock of TCA. In September, 1937, operations were started between Winnipeg and Vancouver, and on April 1st, 1939, the first transcontinental passenger flight between Montreal and Vancouver was started. Domestic route expansions continued throughout the years until a route pattern linking all major Canadian cities and eight cities of the United States was completed. In 1942 the Company undertook to operate a trans-Atlantic service for the Government carrying mail for Canadian troops abroad, and TCA entered the trans-Atlantic civil aviation field in April, 1947, when the war-inspired Government trans-Atlantic service ceased to exist. In 1948 TCA started services between Canada and Bermuda as well as British points in the Caribbean.

Principal routes : transcontinental, trans-Atlantic to England, Scotland and Ireland, Montreal and Toronto to Tampa/St. Petersburg, The Bahamas and Jamaica; Montreal to Bermuda, Barbados and Trinidad.

G. R. McGregor, President

35 Canadian Pacific Air Lines Ltd. (CPA)

Windsor Station, Montreal, Quebec.

Canadian Pacific Air Lines was formed in 1942 through the merger of ten smaller regular air carriers and bush operators. The Company integrated the services run by the various lines into a close-knit route network and soon began to go farther afield. Early in 1944 it announced that it was preparing a regular air service across the North Atlantic. A few months later, however, the Canadian Government declared that its own "chosen instrument," Trans-Canada Air Lines, would be solely responsible for carrying out international and domestic trunk services, and that Canadian Pacific Railways would have to divest itself of the ownership of its airline interest. However, no order to this effect was ever issued, and the Canadian Government even authorized CPA to operate the Pacific services which it was scheduled to inaugurate this summer. —CPA made a major contribution to the war, namely, the ferrying of bombers across the Atlantic. The Company controlled this service for thirteen months before it was taken over by RAF Ferry Command. It also participated successfully in the British Commonwealth Air Training Plan, and under this scheme it operated six air observer schools on a non-profit basis.

Principal routes : trans-Pacific from Vancouver to San Francisco, Honolulu and Sydney and Vancouver to Anchorage, Shemya, Tokyo and Hong Kong ; domestic services operated in Canada on a general north-to-south basis.

Grant W. G. McConachie, President

Latin American Airlines

36 Aerolineas Argentinas—FAMA

Paseo Colon 185, Buenos Aires.

Flota Aerea Mercante Argentina (FAMA) was established in February, 1946, under a decree issued on December 31st, 1945, as a partly privately and partly Government-owned corporation. Private shareholders subscribed 2/3 of the capital, the Government the rest. FAMA inaugurated its operations on June 4th of the same year with a flight to London and rapidly extended its network in the following twelwe months. However, the Company was soon found to be incurring disastrous losses, as did the other three semi-State controlled Argentine airlines founded at the same time (ALFA, ZONDA and Aeroposta), and on May 3rd, 1949, the Argentine President issued a decree nationalizing the four companies. On June 14th the ensuing reorganization was completed and FAMA was renamed Aerolineas Argentinas FAMA. In spite of these measures the companies continued to lose money, and for this reason the Minister of Transport, Lt.-Col. Juan F. Castro, decided late last year to merge the four lines under the same name, and this took effect on January 1st, 1950. Operations were divided into a domestic division and a foreign division.

Principal routes : Buenos Aires to Rio de Janeiro, Natal, Dakar, Lisbon, Madrid, Rome, Paris, London ; to Sao Paulo ; to Santiago de Chile ; domestic services.

Lt.-col. Juan F. Castro,
Minister of Transport

37 Linea Aerea Nacional (LAN)

Los Cerillos, Santiago de Chile.

LAN inaugurated its existence on March 5th, 1929, under the name of Linea Aero-Postal Santiago-Arica and was under the direct control of the Air Force High Command until the middle of 1932. In that year it was given autonomous legal status, renamed Linea Aerea Nacional and given an air transport monopoly for the territory of Chile, Highlights in the Company's development were the opening of a service to Magallanes, Chile's southernmost city, in 1946, and, in the same year, the inauguration of LAN's only international service, that to Buenos Aires. LAN's operations have distinguished themselves by their high safety factor, and in 1942, 1944, 1945 and 1946 the Company was awarded the Air Safety Award of the Inter-American Safety Council.—LAN continues to be owned by the Chilean Government. Its Administrative Council and General Manager (Executive Vice-President) are appointed by the President of the Republic.

Principal routes : Santiago to Buenos Aires ; Magallanes, Punta Arenas ; Valparaiso ; Arica ; etc.

Juan del Villar Araya,
Executive Vice-President

38 Panair do Brasil (Panair)

Avenida Rio Branco 85, Rio de Janeiro

Panair do Brasil is the successor to the Brazilian subsidiary of the American company NYRBA (New York—Rio—Buenos Aires Line), NYRBA DO BRASIL, which was formed in 1929. Pan American Airways in 1930 bought up NYRBA and NYRBA DO BRASIL and changed the latter's name to PANAIR DO BRASIL. For many years Panair do Brasil was practically 100 % owned by Pan American, but by the end of 1944 PAA's interest had been reduced to 58 % and large proportions of succeeding stock issues were acquired by Brazilian nationals. As a result, Panair is now 52 % Brazilian-owned. Panair do Brasil started its operations on November 28th, 1930, when it inaugurated an air mail service between Belem and Santos. The first international operation was inaugurated a year later with the extension of the line to Buenos Aires. During the war Panair's operations expanded considerably in connection with Brazil's growing war effort, one of its most notable achievements being its active cooperation with the Rubber Development Corporation in the Amazon valley. Following the end of hostilities in Europe, Panair began to prepare its overseas operations. The Company received its first Lockheed "Constellation" in March, 1946, and by the end of 1947 Panair connected Brazil with French West Africa, Portugal, France, England, Italy, Egypt and Turkey.

Principal routes : Rio de Janeiro to Montevideo ; to Buenos Aires ; to Lisbon—Paris—London ; to Lisbon—Madrid—Zurich ; Madrid—Rome—Istanbul ; Paris—Stuttgart ; plus a considerable network linking 64 points in Brazil.

Dr. Paulo de Oliveira Sampaio,
President

39 Servicos Aereos Cruzeiro do Sul, Ltda.

Avenida Rio Branco 128, Rio de Janeiro.

Following a series of proving flights in 1926, the Sindicato Condor Ltda. was formed on December 1st, 1927, with substantial German assistance. In 1941 the German interests were partly eliminated and the Company was renamed Servicos Aereos Condor Ltda. Finally, in 1943, Condor was completely reorganized, renamed Servicos Aereos Cruzeiro do Sul, and all German influence eliminated. To-day the Company is completely privately-owned without foreign participation.

Principal routes : A large network of services along the Brazilian coast and in the interior ; services from Rio de Janeiro to Buenos Aires ; routes to Montevideo, Santiago de Chile and Caracas are planned ; it also has been awarded a CAB foreign air carrier permit for a route from Rio de Janeiro to New York or Washington via Port of Spain, San Juan or Cindad Trujillo.

Dr. José Bente Ribeiro Dantas,
President

40 S.A. Empresa de Viacao Aerea Rio Grandense (VARIG)

Avenida Borges de Medeiros 445, Porto Alegre, Brazil.

VARIG is the oldest formally organized airline in Brazil. It was formed on May 7th, 1927, by private citizens of the State of Rio Grande do Sul, with the assistance of German interests connected with what later became the Condor Syndicate (now Servicos Aereos Cruzeiro do Sul). In 1932 the State of Rio Grande do Sul acquired 21 percent of the VARIG stock, and in 1941 the Brazilian Government brought about another reorganization to oust the concealed German influence. In the middle of 1946 VARIG doubled its capital to Cr. 2,000,000, and present ownership includes 25 percent interest held by the State of Rio Grande do Sul, 10 percent by the Federal Government and municipalities, and 65 by private residents of the State of Rio Grande do Sul. VARIG's operations were largely confined to this state until 1946—with exception of the Montevideo route opened in 1949—when the Company started several inter-state services.

Principal routes : Rio de Janeiro to Montevideo ; from Porto Alegre to about 25 domestic stations.

41 Aerovias Nacionales de Colombia (AVIANCA)

Carrera 9, Calle 12, Bogota.

Avianca's principal predecessor company, Sociedad Colombo-Alemana de Transportes Aereos (Scadta), organized at the end of 1919 by German aviation pioneers (Dr. Peter Paul v. Bauer, von Krohn, etc.) is described as "America's oldest airline." In 1931 Pan American Airways acquired an 80 percent interest in

Scadta. The Colombian Government in 1939 decided to merge Scadta with Servicio Aereo Colombiano (Saco) in order to form Avianca, and the merger was approved in 1940. Of the present capital, PAA holds 48 percent, whereas 10 percent is still owned by P. P. von Bauer, now a naturalized Colombian citizen. Avianca seems to have overcome a series of immediate post-war difficulties (equipment and labour trouble) and in addition to a vast interior has started a cautious overseas operating programme. The first major route of this programme is that to the United States, which eventually is to be followed by services to Europe via the mid-Atlantic.

Principal routes : Bogota to Miami and New York ; to Panama ; Quito ; internal services (65 cities).

Dr. Jorge Restrepo Hoyos, President and General Manager

42 Linea Aeropostal Venezolana (LAV)

Bloque No. 1, El Silencio, Caracas.

The establishment of Linea Aeropostal Venezolana took place in 1933 when the Venezuelan Government decided to nationalize the Venezuelan branch of Aeropostale, pioneer French air carrier. It operated directly under the Ministry of Labour and Communications until 1937, when it was made an autonomous Government-owned concern. In October, 1945, LAV was placed under the Office of Transportation in the new Ministry of Communications. Finally, in 1947 the Government issued a decree regulating LAV's administration and activities in considerable detail and bringing its capitalization to the present level. In 1946 the Company opened regular services to New York ; a reorganization carried out in 1947 placed LAV's operations under a Domestic and an International Division, respectively.

Principal routes : from Caracas to New York ; Maracaibo ; Santo Domingo ; Ciudad Bolivar ; Aruba ; Trinidad ; Havana ; etc.

43 Aerovias Guest S.A.

Reforma 95, Mexico City.

Aerovias Guest S.A. was organized in 1946 by Mexican and U.S. financial interests. Mexicans at present hold 60 percent, Americans (Winston Guest) 40 percent of the stock. The Company holds a 30-year Government concession for a regular mail, cargo and passenger service on the Mexico City—Madrid route, which was inaugurated in January, 1948. Aerovias Guest is planning to extend the service to Paris and London and has also applied for permission to operate to New York.

Principal routes : Mexico City—Lisbon—Madrid.

44 Compania Cubana de Aviacion S.A.

Prado 252, Havana.

Cubana is the successor of a company established in Cuba in 1929 by the Curtiss Aeroplane Co., Compania Nacional Cubana de Aviacion Curtiss, S.A. On May 6th, 1932, Pan American Airways acquired all outstanding stock and in 1934 shortened the Company's name to its present style. Cubana's international operations were inaugurated after the war when it started services to Miami ; last year the Company opened its route to Madrid and hopes to extend it to Barcelona and Paris some time in the future. Pan American gradually reduced its holding to the present level of 52 percent.

Principal routes : Havana—Bermuda—Azores—Lisbon—Madrid ; Havana—Miami ; Cuban local services.

African Airlines

45 Misrair

Almaza Airport, Heliopolis, Egypt.

Misr Airwork was incorporated in 1932 with the overwhelming financial backing of the Misr Bank, which was founded in 1920 to encourage Egyptian enterprises until they became self-supporting. Misr Airlines—which in 1949 was changed to Misrair—is the air transport division of Misr Airwork. The Company flourished in the years before the war. When hostilities broke out, it was taken over by the Government but retained its identity. It carried heavy loads of military passengers and goods and expanded its services. After the war it passed through a severe equipment crisis, which was finally solved by the purchase of twin-engined Beechcrafts and "Vikings." Misrair opened its first long overwater route—to Geneva—in the spring of last year.

Principal routes : Cairo to Baghdad ; Teheran ; Damascus ; Beirut ; Jeddah ; Nicosia ; Istanbul ; Geneva ; domestic services.

H. Exc. Mohamed Roushdy Bey, General Manager

46 South African Airways (SAA)

South African Railways and Harbours & Airways Administration, Johannesburg, Union of South Africa.

The South African Government in February, 1934, acquired Union Airways Ltd., and, under the name of South African Airways, made it a subsidiary of South African Railways, an autonomous Government corporation, and a integral part of the South African Railways & Harbours & Airways Administration. In 1935 the Government also acquired South West African Airways, thus bringing under Government control all internal air routes. From 1937 SAA's growth was greatly stimulated by the Empire Air Mail Scheme, which was abandoned upon the outbreak of hostilities. SAA was forced to curtail and later suspend its operations during the war, because its 18 Junkers Ju-86 and 28 out of 29 Lockheed "Lodestars"—which had just arrived—were requisitioned for military purposes, leaving the Company with only 11 Junkers Ju-52s. Since the war the organization has rapidly expanded, despite lack of equipment due to the dollar shortage, and with the delivery of its new "Constellations" SAA will branch out to new European destinations and possibly across the North Atlantic.

Principal routes : from Johannesburg to Capetown ; East London ; Durban ; Salisbury (S. Rhod.) ; Port Elizabeth ; Lourenco Marques ; Cairo ; London, Routes to Amsterdam and New York are projected.

Major-General C. J. Ventner, Chief Airways Manager

47 Central African Airways Corporation (CAA)

Salisbury, S. Rhodesia.

Central African Airways was set up on June 6th 1946, as the successor of the former Rhodesia and Nyasaland Airways. It is jointly owned by the Government of Southern Rhodesia, Northern Rhodesia and Nyasaland. Under the control of the Central African Air Transport Authority, it is required to provide air services within the Central African territories and feeder services to link with the routes to and through other territories. For the last two years CAA has encountered considerable difficulties and lost large sums of money (£290,000 for 1947-1948). A thorough reorganization to rationalize operations and equipment was undertaken by a new management in the early summer of 1949. Central African Airways still operates in the "red," however, and it still requires subsidies to enable it to play its allotted part in the development of Central Africa. With the constant drive for more economic operating methods and the search for wider markets, the management aims to reduce the subsidy requirement to nil as soon as possible—and at the same time to live up to the CAA motto : "Conservimus Africae Alis"—"We serve Africa with wings."

Principal routes : Salisbury to Johannesburg ; to Nairobi ; Ndola to Elisabethville (Belgian Congo) and Johannesburg ; etc.

48 West African Airways Corporation (WAAC)

Airways House, Lagos, Nigeria.

West African Airways Corporation was established in May, 1946, as a public Corporation under the jurisdiction of the (British) West African Air Transport Authority. It is owned jointly by the Governments of Nigeria, the Gold Coast, the Gambia and Sierra Leone. WAAC has a technical advisory agreement with BOAC, but the latter has no financial interest in it. The Company is empowered to issue stock to the extent of £700,000 but so far has used its borrowing powers to the extent of only £565,000. Operations began late in 1947 on the Lagos—Kano route and reached a route mileage of about 7,500 by the middle of 1950.

Principal routes : serving about 20 stations in Nigeria, the Gold Coast, the Gambia, Sierra Leone and French West Africa.

49 East African Airways Corporation (EAA)

Shell House, Delamere Avenue, Nairobi Kenya.

Incorporated on January 1st, 1946, to provide air services between the Territories of Kenya, Uganda, Tanganyika and the Protectorate of Zanzibar, East African Airways commenced operations with six de Havilland "Dominies" ("Dragon Rapides") as the basic air fleet. In 1947 six more "Dominies" were acquired, four de Havilland "Doves" and five Lockheed "Lodestars" followed in 1948, another eight "Lodestars" and three DC-3s in 1949. The company now operates more than 60 scheduled services a week, including one to Durban and another to Salisbury. It now has eliminated its initial operational losses and showed a profit for 1949. Capitalization is provided proportionately by the Governments of Kenya, Tanganyika, Uganda and Zanzibar.

Principal routes : Linking 23 stations in East Africa, including Nairobi, Mombasa, Tanga, Dar es Salaam, Lindi, Nachingwea, Entebbe, Kisumu, Durban (S. Africa), Salisbury, Zanzibar, Iringa, Mbeya, etc.

50 Divisao de Exploracao dos Transportes Aereos (DETA)

Lourenco Marques, Mozambique.

DETA was formed in 1937 as a special division of the Administration of Ports, Railways and Transports, and the first service, Lourenco Marques to Johannesburg, was opened in December of that year. DETA grew steadily after that ; it suffered no ill effects from the war excepting the temporary suspension of its first route, and has since considerably expanded its operations.

Principal routes : Lourenco Marques—Johannesburg ; Beira—Salisbury (S. Rhod.) ; Beira—Mocimbon.

Near and Far Eastern Airlines

51 Cyprus Airways Ltd.

1, Onasagoras St., Nicosia, Cyprus.

Cyprus Airways is an affiliate of British European Airways Corp., which holds 44.5 percent of the Company. Formed on September 24th, 1947, it started its services on December 8th of the same year and has gradually expanded since.

Principal routes : Nicosia to Cairo, Haifa, Lydda, Athens, Rome, Ankara, Istanbul, Khartoum.

52 Compagnie Générale de Transport (CGDT) - Lignes Aériennes Libanaises

Beirut

The constitution of the CGDT was authorized by Presidential decree in 1945, and the Company was formed by a number of prominent Lebanese and Syrian personalities. It is affiliated with Air France, but the extent of Air France's interest is not known. Operations were started with two Junkers Ju 52s in 1946 ; this fleet was increased by three DC-3s over the next two years, and by the end of 1948 the Company had raised its weekly aircraft mileage to 15,500, compared with 5,000 miles in 1946. CGDT is planning to extend its operations to Paris, Dakar, Lagos and Mecca.

Principal routes : Beirut to Cairo ; Jeddah ; Koweit ; Istanbul ; Baghdad.

53 Iraqi Airways

Baghdad

Iraqi Airways was organized in December, 1945, as a department of Iraqi State Railways and began operations in February, 1946. The original financing, totalling I.D. 77,500, came from the 1945-1946 Iraqi State Railway budget, and any profits or losses are absorbed by the Iraqi Government. British Overseas Airways Corporation provides technical assistance and certain key personnel to Iraqi.—Iraqi Airlines operates predominantly international routes ; major purpose of the London service is the overhaul of the line's aircraft in England.

Principal routes : Baghdad to Basrah—Kuwait—Bahrein ; Tehran ; Damascus—Cairo ; Beirut.

54 Air-India International Ltd.

New India Assurance Building, Mahatma Gandhi Road, Fort, Bombay.

Air-India International, Ltd., was promoted by Air-India Ltd. in cooperation with Tata Industries Ltd. and the Government of India and has the right to operate all external services from India to the West. The Government holds 49 percent of the issued capital and has an option to acquire a further 2 percent at any time. Air India Ltd. are the General Technical Managers and provide operational, engineering and administrative services for the operations of the company. They also are the General Agents for Air-India International in India. The company commenced its services from Bombay to London via Cairo and Geneva on June 8th, 1948. At present it is operating three services a week on the Bombay—Cairo—Geneva/Rome—London route and one service a week on the Bombay—Karachi—Aden—Nairobi route. It shortly expects to increase the frequency of its services to London to four times a week and to extend two of these frequencies to Calcutta.

Principal routes : Bombay—Cairo—Geneva/Rome—London; Bombay—Karachi—Aden—Nairobi.

J. R. D. Tata,
Chairman, Air-India Ltd. & Air-India International

55 * Indian Overseas Airlines Ltd.

Santa Cruz Airport, Bombay 25.

Indian Overseas Airlines is the air transport affiliate of an Indian industrial corporation and was registered as Mistri Airways Ltd. in 1946. It changed its name late in 1947. Operations began in 1946 on the Bombay—Calcutta route. The Company plans to open services from Calcutta to Sydney, via Singapore and Indonesia, as well as routes from Bombay to Karachi and Tehran.

Principal routes : Bombay—Calcutta ; Lucknow—Nagpur ; Madras—Delhi.

56 * Deccan Airways Ltd.

Airport, Begumpet, Hyderabad.

Deccan Airways, Ltd., was formed during the month of September, 1945, with an authorized capital of Rs. 10,000,000, consisting of 100,000 shares of Rs. 100 each. Out of these, 65,000 shares have been subscribed and paid up fully. Seventy-five percent of the shares outstanding have been taken up by the Hyderabad State Government and the State Railway.—The management of the company is vested in a Board comprising a Chairman and five Directors. The company started operations from July, 1946, and is at present operating services with Douglas DC-3s under a term licence granted by the Government of India. The head office of Deccan Airways, the workshops and maintenance base are situated at Begumpet Airport. They were moved to that location on May 8th, 1950, from Hakimpet airfield.

Principal routes : Madras—Delhi—Madras ; Hyderabad—Bangalore—Hyderabad ; Hyderabad—Bombay—Hyderabad, etc.

P. M. Reddy, General Manager

57 Pak Air Ltd.

Bombay, Pakistan.

Pak Air Ltd. is one of the two Pakistan air carriers to be awarded route concessions under the Pakistan Government's civil aviation policy announcement of December 4th, 1947 (the other : Orient Airways). Pak Air is endeavouring to become Pakistan's overseas flag carrier and plans extensive services to Singapore, Australia (Sydney), Ceylon, Cairo and London. In 1948 it signed a $1 000 000 agreement with Transocean Air Lines of Oakland, Calif., under which TAL provided Pak Air with aircraft (DC-4s and DC-3s), air crews and technical assistance.

Principal routes : Karachi to Delhi, Lahore, Peshawar, Bombay, etc.

58 Air Ceylon

Ceylon Government Airlines, Lotus Road, Fort, Colombo, Ceylon.

In 1946 the Ceylon Government authorized the purchase of three Douglas DC-3 "Dakota" aircraft and the setting up of a Civil Aviation Department to operate internal and external scheduled services. Internal non-scheduled operations were carried out in 1947 during the formation period. On December 1st, 1947, the first scheduled service commenced on the Colombo—Jaffna—Madras route. During the early part of 1948 the frequency of operation was stepped up and on August 17th, 1948, a new service was inaugurated to Trichinopoly. On February 7th, 1949, two Douglas DC-4 "Skymasters" were added to the Air Ceylon fleet of three "Dakotas." The Ceylon Government entered into a contract with Australian National Airways Pty. Ltd., whereby the latter organization would operate an international service extending from Colombo to London and to Singapore. A weekly service in each direction was established. In January 1950, the international "Skymaster" service was extended from Singapore to Australia.

Principal routes : Colombo to Jaffna, Trichinopoly, Madras, Bombay, Karachi, Cairo, Rome, London, Singapore and Sydney.

59 Philippine Air Lines Inc. (PAL)

M. R. S. Building, Manila, Philippines.

Philippine Air Lines today is the Government's chosen instrument and the only Philippine scheduled airline. It achieved its present position as a major Asiatic air carrier through the acquisition of two other airlines. One of these was Far Eastern Air Transport Inc. (FEATI) which originally was incorporated as Iloilo-Negros Air Express Co. (INAEC) in April, 1932, but changed its name in November, 1945 ; FEATI was bought by PAL in May, 1947. The second company, acquired by PAL in September, 1946, was Commercial Air Lines Inc. (CALI), which was formed only after the war, in May, 1946. The old PAL was incorporated in February, 1941, the successor to Philippine Aerial Taxi Co., which was organized by US interests in 1931 and later renamed Philippine Air Transport Co. (PATCO). The latter company went into bankruptcy in 1940. PAL and FEATI were the first to resume operations after the war, FEATI on November 19th, 1945, and PAL on February 14th, 1946, and the two companies operated competitive domestic networks. In August, 1946, the newly organized Philippine Civil Aeronautics Board approved the purchase by PAL of both CALI and FEATI. Prior to the completion of these transactions, both FEATI and PAL had begun non-scheduled flights across the Pacific to the US and on June 5th, 1947, the US Civil Aeronautics Board granted the route to PAL: regular operations started on October 27th, 1947. The second major international route, that to London, was inaugurated on July 24th, 1948, and extended to Amsterdam shortly after.

Principal routes : Manila, Guam, Wake, Honolulu, San Francisco ; Manila—Hong Kong ; Manila—Calcutta—Bangkok—Bombay—Karachi—Cairo—Rome—Madrid—London—Amsterdam.

Col. Andres Soriano, President

60 China National Aviation Corporation (CNAC)

2, Tientsin Road, Shanghai (now reported moved to Canton).

A year after its foundation in 1929 as a wholly Government-owned enterprise, China National Aviation Corporation was reorganized with a capital of CN $10,000,000 as a Sino-American company, 55 %-owned by the Chinese Government and 45 % by Chinese Airways Federal, Inc., an American concern. Pan American Airways bought the latter's holding in 1933. CNAC was again reorganized in 1946, with a capital of CN $2,500,000,000, 80 percent of which is held by the Kuomintang Government, 20 percent by Pan American Airways.—As a result of the establishment of the Chinese Popular Republic the Company became inoperative. Most of its fleet fled to Hong Kong, where General Chennault's Civil Air Transport Company claimed to have acquired the assets of CNAC. This was disputed by the Chinese Reds, and the aircraft presumably are still at Hong Kong.

61 Central Air Transport Corporation (CATC)

2, Taming Road, Shanghai.

The predecessor company of Central Air Transport Corporation was Eurasia Aviation Co., which was established in 1931 under an agreement between the Chinese Government and the Deutsche Lufthansa ; the Chinese Government held a two-thirds interest in the corporation. The company set up a dense network of services with the ultimate purpose of flying to Europe. When war broke out, Eurasia was inoperative for a time and, in 1943, the Chinese Government dissolved it and re-incorporated the organization as a fully Government-owned corporation. After the war CATC obtained equipment from US Army surplus stocks and also placed an order for 6 "Convair-Liners." As a result of the Communist victory in China the company became inoperative, and most of its fleet fled to Hong Kong, where it now is the subject of litigation (cf. above, CNAC).

Australian and New Zealand Airlines

62 British Commonwealth Pacific Airlines Ltd. (BCPA)

A. P. A. Building, 53, Martin Place, Sydney, Australia.

British Commonwealth Pacific Airlines Ltd. is owned by the Australian, New Zealand and British Governments, in the proportion of 50 percent by Australia, 30 percent by New Zealand and 20 percent by the United Kingdom. The formation of the Company was first considered during the Inter-Dominion conference on aviation at Montreal in 1944, but it was not created until June 24th, 1946, as a result of the British Commonwealth Civil Aviation Conference in Wellington, New Zealand, in March, 1946. Services on the Sydney—Vancouver route were commenced on September 15th, 1946. Since BCPA had no equipment at the time, operations were conducted on its behalf by Australian National Airways under a contract which expired at the end of April, 1947. On that date BCPA began to fly the Pacific routes itself with Douglas DC-4s, which meanwhile have been replaced with Douglas DC-6s. Previously, on December 4th, 1946, an Australian-US air agreement was signed, giving BCPA the right to pick up and land passengers and cargo on US territory on its flights to and from Vancouver.

Principal routes : Sydney or Auckland to Fiji, Canton Island, Honolulu, San Francisco, Vancouver.

Capt. A. A. Barlow, General Manager

63 Qantas Empire Airways Ltd. (QEA)

Shell House, Carrington St., Sydney.

In 1919 the Australian Federal Government commissioned Lieutenants Hudson Fysh (now Chairman of QEA) and P. J. McGinniss to survey an air route from Darwin to Longreach. This led to the formation of Queensland and Northern Territory Aerial Services Ltd., the original "Qantas" company, on November 16th, 1920. The first regular service was inaugurated in November, 1922. On January 18th, 1934, Qantas Empire Airways was registered and the Company secured the airmail contracts for its first overseas service, the Brisbane—Singapore line. The initial capital of the Company was owned on a 50-50 basis by the original Queensland and Northern Territory Aerial Services Ltd. and Imperial Airways Ltd.; upon the formation of British Overseas Airways Corporation, the latter took over IAL's holding. On March 21st, 1947, the Australian Government purchased BOAC's interest in Qantas Empire Airways ; on July 1st, 1947, it also bought the holding of the original Qantas company and thus became the sole shareholder of QEA. On December 1st, 1947, the Company inaugurated its major high-speed trunk route, the Sydney—London "Constellation" service.—QEA is the Commonwealth Government's chosen instrument for the development and operation of Australian external airline services, the Government's domestic services being the responsibility of Trans-Australia Airlines.

Principal routes : Sydney to London ; Hong Kong ; Tokyo (for RAAF) ; Lae (New Guinea) ; internal New Guinea services ; etc.

W. Hudson Fysh,
Chairman and Managing Director

64 * Trans Australia Airlines (TAA)

339, Swanston Street, Melbourne, C. 1.

Trans Australia Airlines was set up in 1946 by the Government's Australian National Airlines Commission which in turn had been created under the Australian National Airlines Act of 1945. The Act authorized the Government to engage in air transportation, but the constitutionality of the Act has been challenged ever since by the Australian privately-owned companies. TAA started operations on September 9th, 1946, with a flight between Melbourne and Sydney, and by December of that year all State capitals had been linked. TAA claims to serve the largest unduplicated route mileage of any internal airline in the world. The Government has set TAA the important task of developing the Australian outback, and two of its main services, namely, from Adelaide to Darwin and Brisbane, pass through vast stretches of country in which each town is many hundreds of miles away from its nearest neighbour.

Principal routes : domestic air services connecting 31 points.

L. J. Brain, General Manager

65 * Australian National Airways Pty., Ltd. (ANA)

390, Flinders Street, Melbourne, C 1.

The inaugural operation of Australian National Airways took place in 1932, when Captain Victor Holyman, of the well-known shipping family of that name, bought a D.H. "Fox Moth" aircraft and opened a service between Launceston and Flinders Island, across the Bass Strait. His company, Holyman Airways Pty., Ltd., expanded rapidly and gradually bought up other companies, including Adelaide Airways, West Australian Airways, and Airways of Australia. The resultant Australian National Airways was formally registered on July 1st, 1936, with a capital of £A500,000 subscribed mainly by four Australian and one New Zealand shipping companies, which still own about 94 percent of the present issued capital of £A1,000,000. In recent years ANA's expansion as a scheduled carrier has been checked by the subsidized competition of the Australian Government's Trans Australia Airlines. ANA has been forced to look to the international contract carrier market to extend its activities (see British Commonwealth Pacific Airlines !) and is now operating the Singapore—Colombo—London service for Air Ceylon. In addition to its regular domestic services, it flies numerous charter flights to Rome and Hong Kong.

Principal routes : domestic, connecting the capitals of all Australian States ; overseas operations as contractors for Air Ceylon.

Ivan Nello Holyman, President

66 Tasman Empire Airways Ltd. (TEA)

Mechanics Bay, Auckland, New Zealand.

Purpose of the formation of Tasman Empire Airways in 1939—following negotiations extending more than three years—was the establishment of the final link in the Empire airways system from the United Kingdom to India, Australia and New Zealand. The company began operations on the trans-Tasman sea route at the end of April, 1940. It is owned by the three Governments interested in the service : 39 percent by the Government-owned New Zealand National Airways Corporation, 38 percent by the British Overseas Airways Corp., and 23 percent by the Australian Government's Qantas Empire Airways.

Principal route : Auckland—Sydney.

Sir Leonard Isitt,
Chairman, TEA and NZNAC

67 New Zealand National Airways Corporation (NZNAC)

Post Office Box 3038, Wellington C. 1, New Zealand.

Under the New Zealand National Airways Act of 1945 the three companies operating domestic routes, Union Airways, Air Travel (NZ) Ltd., and Cook Strait Airways, were nationalized in August, 1946, to form one comprehensive airline, NZNAC. The Corporation is responsible for domestic services but also flies routes beyond the mainland, such as those to Fiji.

Principal routes : Auckland to Fiji, Samoa, etc. ; domestic services.

"Who's Who"

1. **CAPITALIZATION :** **A** = Authorized ; **I** = Issued or present ; **L** = Long-term loan ; **O** = Original.

2. **OWNERSHIP :** **AF** = Air France ; **Airwk.** = Airwork Ltd. ; **ANA** = Australian National Airways ; **G** = Government ; **Grace** = W. R. Grace & Co ; **Maj.** = Majority ; **Misr** = Misr Bank ; **P** = Private ; **ScAv.** = Scottish Aviation, Ltd. ; **SL** = Shipping Lines.

3. **MANAGEMENT—EXECUTIVE CAPACITIES :**

A-Jets	Adviser, Jet Development	DC	Deputy Chairman	GM-O	General Manager—Operations	TrM	Traffic Manager
AGM	Assistant General Manager	DChEx	Deputy Chief Executive	M	Manager	VP-En	Vice President-Engineering
AMD	Assistant Managing Director	DG	Director General	MD	Managing Director	VP-GC	Vice President-General Counsel
C	Chairman	DMD	Deputy Managing Director	OD	Operations Director	VP-GM	Vice President-General Manager
ChAM	Chief Airways Manager	Ea. Div.	Eastern Division	OM	Operations Manager	VP-O	Vice President-Operations
ChAS	Chief Airways Superintendent	ExAsstP	Executive Assistant to President	P	President	VP-S	Vice President-Sales
ChEn	Chief Engineer	ExVP	Executive Vice-President	SM	Sales Manager	VP-Tr	Vice President-Traffic
ChEx	Chief Executive	FRM	Foreign Relations Manager	T	Technical	We. Div.	Western Division
CD	Commercial Director	GM	General Manager	TD	Technical Director		
CM	Commercial Manager	GM-C	General Manager—Commercial	TM	Technical Manager		

	NAME	YEAR OF FOUNDATION	CAPITALIZATION (1)	OWNERSHIP (2)	MANAGEMENT NAME	MANAGEMENT CAPACITY (3)	AIR FLEET	ROUTE MILEAGE (Unduplicated)
EUROPEAN AIRLINES								
1	**BOAC** British Overseas Airways Corporation	1940	A : £60,000,000 I : £35,000,000 O : £ 4,250,000	G	Sir Miles Thomas Whitney W. Straight Sir Victor H. Tait J. W. S. Brancker Sir Frank Whittle	C DC OD GM-C A-Jets	11 Lockheed "Constellations" 10 Boeing "Stratocruisers" 22 Canadair DC-4M-2s 25 H. P. "Hermes" 17 Avro "Yorks" 5 Avro "Lancastrians" 10 Short flying-boats 100	72,000 miles 116,000 km
2	**BEAC** British European Airways Corporation	1946	A : £20,000,000 I : £ 6,000,000 O : £ 6,000,000	G	Lord Douglas of Kirtleside Peter Masefield P. C. F. Lawton A. H. Milward G. O. Waters	C ChEx CM GM Cont. GM Brit.	20 Airspeed "Ambassadors" 42 Vickers "Vikings" 30 Douglas DC-3s 20 D. H. "Dragon Rapides" 3 Helicopters 115	13,160 miles 21,178 km
3	**ALT** Aer Lingus Teoranta	1936	A : £5,000,000 I : £ 952,000 O : £ 100,000	60 % G 30 % BEAC 10 % BOAC	J. F. Dempsey Maj.-Gen. M. Hogan Capt. J. C. Kelly-Rogers Capt. W. J. Scott Capt. P. McCormack	GM AGM AGM(T) OM ChEn	14 Douglas DC-3s 1 Airspeed "Consul" 15	2,213 miles 3,561 km
Scandinavian Airlines System								
4	**ABA** AB Aerotransport	1924	I : Kr. 50,000,000 O : Kr. 356,000	50 % G 50 % P	Per A. Norlin Karl Lignell Ake Weimar Olaf Carlstein A. Wickberg	P ExVP VP-O VP(Maint.) VP-S	8 Douglas DC-6s 5 Douglas DC-4s 14 Douglas DC-3s 27	
5	**DNL** Det Norske Luftfartselskap A/S	1918/1946	A : Kr. 25-30,000,000 I : Kr. 25,250,000	50 % G 50 % P	Maj. Gen. Hj. Riiser-Larsen Johan Bostad Paul H. Kanter Henrik W. Ree	P VP-O VP-Tr,S VP-En	2 Douglas DC-6s 2 Douglas DC-4s 10 Douglas DC-3s 2 Short "Sandringhams" 4 Junkers JU 52s 20	90,000 miles 145,000 km for entire SAS
6	**DDL** Det Danske Luftfartselskab A/S	1918	I : Kr. 30,000,000 O : Kr. 1,000,000	17 % G 83 % P	Per Kampmann K. Kalm K. Lybye	P ExVP VP	2 Douglas DC-6s 2 Douglas DC-4s 11 Douglas DC-3s 15	
7	**Aero O/Y** Finnish Airlines	1923	I : Fmk. 60,000,000 O : Fmk. 50,000	73 % G	Lt.-Gen. Leonard Grandell Adolf Nyström Bertel Aulin	P & MD CD TD	8 Douglas DC-3s 2 Junkers Ju 52s 10	3,136 miles 5,046 km
8	**KLM** Royal Dutch Airlines Koninklijke Luchtvaart Maatschappij N. V.	1919	O : Fl. 1,000,000 A : Fl. 100,000,000 I : Fl. 57,954,000	•	Dr. Albert Plesman Dr. M. J. van der Ploeg F. von Baltusek F. Besançon S. Van den Bent Dr. L. H. Slotemaker	P ExVP VP-T VP-Prod VP VP	17 Lockheed "Constellations" 7 Douglas DC-6s 10 Douglas DC-4s 22 Douglas DC-3s 12 Convair-Liners 1 Auster J-1 69	90,700 miles 146,000 km
9	**SABENA** Société Anonyme Belge d'exploitation de la Navigation Aérienne	1923	I : B. Fr. 300,000,000 O : B. Fr. 6,000,000	50 % G 50 % P	Gilbert Périer Gaston Claeys Willem Deswarte Leon Schoevaerts Anselme Vernieuwe Fernand de Ridder Félicien Pirson	P MD GM CD OD TD TD	5 Douglas DC-6s 8 Douglas DC-4s 25 Douglas DC-3s 6 Convair-Liners 4 D. H. "Doves" 2 Bell 47 D1 Helicopters 10 Miscellaneous 60	35,000 miles 60,000 km
10	**COBETA** Compagnie Belge de Transports Aériens	1943	—	P	Marcel L. M. Dens	MD	2 Douglas DC-4s 2 Douglas DC-3s 14 Miscellaneous 18	4,500 miles 7,240 km
11	**SWISSAIR** Swiss Air Transport Co. Ltd.	1931	I : Sw. Fr. 20,000,000 O : Sw. Fr. 800,000	30 % G 70 % P	Dr. Rudolf Speich Dr. Walter Berchtold Eugène Groh Gottfried de Meiss	C MD CD TD	4 Douglas DC-4s 13 Douglas DC-3s 4 Convair-Liners 7 Miscellaneous 28	21,326 miles 34,321 km
12	**AIR FRANCE** Compagnie Nationale Air France	1933/1948	A : Frs. 10,000,000,000 I : Frs. 10,000,000,000 O : Frs. 120,000,000	85 % G 15 % P	Dr. Max Hymans Henry Ziegler René Briend Raymond Dupré Maurice Lemoine	C MD AMD, CD TD ExAsstP	19 Lockheed "Constellations" 28 Douglas DC-4s 29 Douglas DC-3s 31 SE 161 "Languedocs" 107	115,625 miles 185,000 km
13	**IBERIA** Compania Mercantil de Lineas Aereas Espanolas S. A.	1940	A : Ptas. 90,000,000 I : Ptas. 35,400,000 O : Ptas. 12,000,000	G	Jesus Rubio Paz Cesar Gomez Lucia Jose M. Ansaldo M. de las Penas N. Alvarez	C P OM CM ChEn	6 Douglas DC-4s 13 Douglas DC-3s 3 Junkers Ju 52s 4 D. H. "Dragon Rapides" 1 Airspeed "Consul" 27	25,443 miles 40,947 km
14	**TAP** Transportes Aereos Portugueses	1944	State operation	G	Col. Carlos M. Magalhaes Maj. L. C. T. Bettencourt R. O. da Silva	GM TM CM	3 Douglas DC-4s 6 Douglas DC-3s 1 Beechcraft 18 10	7,411 miles 11,856 km
15	**Aero-Portuguesa Lda.**	1934	I : Esc. 5,000,000 O : Esc. 160,000	37.5 % SL 37.5 % AF 25 % P	Antonio de Medeiros e Almeida Frederico de Vasconcelos Cdr. Carlos Nogueira Eugenio Marques Antonio Serodio	P VP GM M M	1 Lockheed "Lodestar" 1 Douglas DC-3s 2	855 miles 1,376 km
16	**ALITALIA** Aerolinee Italiane Internazionali	1946	I : Lire 2,000,000,000 O : Lire 900,000,000	29 % BEAC 51 % G 20 % P	Count Nicolo Carandini Ing. Luigi Acampora Ing. Bruno Velani	C MD OM	4 Douglas DC-4s 8 Siai-Marchetti SM. 95 4 Avro "Lancastrians" 16	18,888 miles 30,398 km
17	**ALI** Avio Linee Italiane —Flotte Riunite	1926/1949	I : Lire 1,000,000,000 O : Lire 2,000,000	Maj. Fiat	Dr. Guido Ulisse Ringler General Felice Porro Major Aldo Casale A. Buzio L. Schiona Dr. D. Miaio Ing. A. Farini	P VP VP CM OM Adm. M. FRM	3 Fiat G. 212 4 Fiat G. 12 12 Douglas DC-3s 19	8,313 miles 13,378 km

	NAME	YEAR OF FOUNDATION	CAPITALIZATION (1)	OWNERSHIP (2)	MANAGEMENT NAME	MANAGEMENT CAPACITY (3)	AIR FLEET	ROUTE MILEAGE (Unduplicated)
18	**LAI** Linee Aeree Italiane	1946	I : Lire 200,000,000 O : Lire 10,000,000	40 % TWA 60 % G & P	Prince Marcantonio Pacelli Cdr. Richard Mazzarrini General Luigi Gallo Maj. Antonio Nervi	C DC MD D-Adm	3 Douglas DC-6s 16 Douglas DC-3s 19	10,681 miles 17,512 km
19	**TAE** Greek Airlines (Technical & Aeronautical Exploitations Co. Ltd.)	1939	I : Drs. 2,168,070,000 O : Drs. 5,000,000	P 35 % TWA	Colonel Stephen A. Zotos George Papaioannou Lt.-Col. L. Papastratigakis Ch. Mytilinaios	MD AMD TM GM-O	10 Douglas DC-3s 1 Fairchild " Forwarder " 11	2,627 miles 4,228 km
20	**" Hellas "** Hellenic Airlines S.A.	1947	I : Drs. 6,875,000,000 O : Drs. 1,000,000,000	60 % G 40 & ScAv.	J. Sakellion Air Vice-Marshal N. Voyazis Ch. Carolou Admiral A. Matessis	P MD DMD GM	5 Douglas DC-3s 1 Consolited " Liberator " 6	4,800 mi. approx. 7,700 km approx.
21	**CSA** Ceskoslovenske Aerolinie	1923	State operation	G	Leopold Thurner Oldrich Ruzicka	DG TD	30 Douglas DC-3s 4 Ilyushin Il-18s 10 Miscellaneous 44	10,000 mi. approx. 16,000 km approx.
22	**LOT** Polskie Linie Lotnicze	1929	State operation	G	Czeslaw Mankiewicz T. Caga-Karpinski Mieczyslav Wegrzecki	DG TD CD	5 SE 161 " Languedocs " 26 Li-2s 4 Ilyushin 12s 5 Douglas DC-3s 40	5,785 miles 9,311 km
AMERICAN & CANADIAN AIRLINES								
23	**PAA** Pan-American World Airways	1927	I : $68,988,957 L : $35,000,000 O : $ 3,378,846	P	Juan Terry Trippe Samuel F. Pryor Willis G. Lipscomb Henry J. Friendly	P VP VP-Tr,S VP-GC	20 Boeing " Stratocruisers " 18 Lockheed " Constellations " 65 Douglas DC-4s 19 Douglas DC-3s 20 Convair-Liners 10 Curtiss " Commandos " 152	56,000 miles 90,000 km
24	**PANAGRA** Pan American-Grace Airways Inc.	1928	I : $4,750,000	50 % PAA 50 % Grace	Andrew B. Shea Douglas Campbell Erwin E. Balluder Gustavo Vidal Thomas J. Kirkland	P VP, GM VP VP VP	6 Douglas DC-6s 10 Douglas DC-3s 4 Douglas DC-4s 20	8,800 mi. approx. 14,200 km approx.
25	**AA** American Airlines, Inc.	1934	A : $72,000,000 I : $46,000,000	P	C. R. Smith L. G. Fritz Wm. Littlewood	P VP-O VP-En	50 Douglas DC-6s 22 Douglas DC-4s 75 Convair-Liners 147	10,817 miles 17,408 km
26	**AOA** American Overseas Airlines, Inc.	1937/1945	A : $3,000,000 I : $1,749,825	P	C. R. Smith H. R. Harris	P VG, GM	8 Boeing " Stratocruisers " 7 Lockheed " Constellations " 9 Douglas DC-4s 1 Douglas DC-3s 25	13,029 miles 20,968 km
27	**TWA** Transcontinental & Western Air Inc. (Trans World Airline)	1926/1930	I : $54,865,776 O : $ 5,000	P	Ralph S. Damon Warren Lee Pierson John A. Collings E. O. Cocke	P C VP-O VP-S	67 Lockheed " Constellations " 14 Douglas DC-4s 59 Douglas DC-3s 12 Martin 2-0-2s 5 Boeing " Stratoliners " 157	26,646 miles 42,883 km
28	**UAL** United Air Lines Inc.	1926/1934	I : $83,126,849 O : $ 7,953,677	P	W. A. Patterson J. R. Herlihy Harold Crary R. W. Ireland	P VP-O VP-S VP-T	7 Boeing " Stratocruisers " 44 Douglas DC-6s 23 Douglas DC-4s 61 Douglas DC-3s 135	13,250 miles 24,400 km
29	***EAL** Eastern Air Lines Inc.	1928/1934	A : $5,000,000 I : $2,994,465 L : $6,666,000	P	Capt. Edward V. Rickenbacker Paul H. Brattain S. L. Shannon M. M. Frost	P, GM 1st VP VP-O VP-Tr,S	20 Lockheed " Constellations " 22 Douglas DC-4s 49 Douglas DC-3s 91	9,704 miles 15,617 km
30	**Northwest Airlines Inc.**	1934	A : $45,000,000 I : $17,829,205 L : $16,710,000	P	Croil Hunter K. R. Ferguson Amos Culbert	P, GM VP-O, En VP-S	10 Boeing " Stratocruisers " 17 Douglas DC-4s 2 Douglas DC-3s 23 Martin 2-0-2s 52	17,204 miles 27,687 km
31	**Braniff Airways Inc.**	1928/1930	I : $2,500,000 O : $ 10,000	P	Thomas E. Braniff Charles E. Beard Ray E. Shrader	P ExVP VP-O	6 Douglas DC-6s 9 Douglas DC-4s 16 Douglas DC-3s 31	10,700 miles 17,200 km
32	**Chicago & Southern Air Lines, Inc.**	1935	I : $5,456,723	P	Carleton Putnam Sidney A. Stewart William T. Arthur	C P VP-O	5 Lockheed " Constellations " 5 Douglas DC-4s 12 Douglas DC-3s 22	5,749 miles 9,252 km
33	**National Airlines, Inc.**	1937	A : 1,600,000 shares I : 1,000,000 shares	P	G. T. Baker John L. Morris Walter Sternberg E. J. Kershaw	P VP VP-S VP-O	6 Douglas DC-6s 7 Douglas DC-4s 10 Lockheed " Lodestars " 2 Curtiss C-46s 25	3,147 miles 5,065 km
34	**TCA** Trans-Canada Air Lines	1937	I : $25,000,000	G	G. R. McGregor W. F. English Anson C. McKim	P VP-O VP-Tr	20 Canadair DC-4M-2s 27 Douglas DC-3s 47	17,152 miles 27,604 km
35	**CPA** Canadian Pacific Airlines Ltd.	1942	I : $9,000,000 O : $4,000,000	Owned by Canadian Pacific Railways	W. G. Grant McConachie Duncan I. McNeill R. W. Ryan W. G. Townley	P VP ExAsstP GM-O	3 Canadair DC-4M-2s 16 Douglas DC-3s 12 Miscellaneous 31	25,496 miles 41,032 km
LATIN AMERICAN AIRLINES								
36	Aerolineas Argentinas **FAMA**	1945	—	G	Lt.-Col. Juan F. Castro	Min. Tr.	5 Douglas DC-6s 10 Douglas DC-4s 5 Convair-Liners 3 Avro " Yorks " 23	10,000 mi. approx. 16,000 km approx.
37	**LAN** Linea Aerea Nacional-Chile	1929	I : Ps. 5,500,000 O : Ps. 250,000,000	G	Juan del Villar Araya Luis Carmona Lopehandia Oscar Gonzales Gonzales	ExVP OM ChEn	4 Martin 2-0-2s 6 Douglas DC-3s 11 Miscellaneous 21	3,000 miles 4,800 km
38	**PANAIR** Panair do Brasil	1929	A : Cr$88,000,000 I : Cr$88,000,000 O : Cr$ 500,000	48 % PAA 52 % P	Dr. Paulo de Oliveira Sampaio Eduardo Schoveri Americo D'Aguiar	P, GM Tr & SM OM	4 Lockheed " Constellations " 19 Douglas DC-3s 5 Consolidated " Catalinas " 28	51,308 miles 82,572 km
39	**CRUZEIRO** Servicos Aereos Cruzeiro do Sul	1927/1942	I : Cr$20,000,000 O : Cr$ 100,000	P	Dr. Jose Bente Ribeiro Dantas Col. Franklin A. Rocha Joao Q. Vieira de Carvalho	P OM CM	2 Douglas DC-4s 22 Douglas DC-3s 4 Beechcraft 18 28	10,200 miles 16,400 km
40	**VARIG** S.A. Empresa de Viacao Aereo Rio Grandense	1927	I : Cr$ 2,000,000 L : Cr$12,000,000 O : Cr$ 1,000,000	21 % G 79 % P	Rubem M. Berta Oscar Siebel Karl H. Ruhl	P, GM VP TD	14 Douglas DC-3s 5 Curtiss " Commandos " 12 Miscellaneous 31	2,700 miles 4,350 km
41	**AVIANCA** Aerovias Nacionales de Colombia	1919/1940	I : Ps. 6,000,000 O : Ps. 800,000	48.2 % PAA 51,8 % P	Dr. Jorge Restrepo Hoyos Jorge A. Gonzalez Col. Ernesto Buenaventura	P, GM ExVP OD	9 Douglas DC-4s 28 Douglas DC-3s 2 Consolidated " Catalinas " 39	10,000 miles 16,000 km
42	**LAV** Linea Aeropostal Venezolana	1933	I : Bs. 14,656,897 O : Bs. 1,156,897	G	Lt.-Cd. Guillermo Pacanins	GM	2 Lockheed " Constellations " 2 Douglas DC-4s 16 Douglas DC-3s 4 Miscellaneous 24	8,300 miles 13,400 km

	NAME	YEAR OF FOUNDATION	CAPITALIZATION (1)	OWNERSHIP (2)	MANAGEMENT NAME	MANAGEMENT CAPACITY (3)	AIR FLEET	ROUTE MILEAGE (Unduplicated)
43	**Aerovias Guest S. A.**	1946	I: Ps. 5,000,000	P	W. F. C. Guest	P	3 Douglas DC-4s	5,756 miles 9,263 km
44	**CUBANA** Compania Cubana de Aviacon S. A.	1930	A: Ps. 1,000,000	52 % PAA 48 % P	Antonio Tarafa Warren A. Pine Capt. Frank Hernandez Gustavo F. Aragoz	P VP, GM OM TrM	4 Douglas DC-4s 6 Douglas DC-3s 10	7,000 mi. approx. 11,300 km approx.
	AFRICAN AIRLINES							
45	**Misrair SAE**	1932	I: £E. 300,000 O: £E. 20,000	85 % Misr 10 % Airwk 5 % P	Mohamed Roushdy Bey Gamal Eldin Kotby Bey	MD, GM DGM	8 Vickers "Vikings" 13 Miscellaneous 21	9,585 miles 15,426 km
46	**SAA** South African Airways	1934	State operation	G	Maj.-Gen. C. J. Venter J. D. T. Louw	ChAM ChAS	7 Douglas DC-4s 5 Douglas DC-3s 19 Lockheed "Lodestars" 4 Lockheed "Constellations" 8 Vickers "Vikings" 1 D. H. "Doves" 44	20,074 miles 32,306 km
47	**CAA** Central African Airways Corporation	1946	L: £880,000 O: £500,000	G	Sir Ellis Robins R. G. McCoy R. A. R. Wieland K. H. Greager	C GM CM ChEn	5 Vickers "Vikings" 3 D. H. "Doves" 2 D. H. "Beavers" 10	4,773 miles 7,637 km
48	**WAAC** West African Airways Corporation	1946	A: £700,000 I: £565,000	G	Sir Hubert Walker G. H. C. Lee D. Malcolm Brown J. Woodhouse Capt. N. G. F. Rose	C GM CM ChEn OM	10 D. H. "Doves" 2 Bristol 170s 12	7,468 miles 12,018 km
49	**EAAC** East African Airways Corporation	1946	I: £221,500 O: £ 50,000	G	Sir Alfred Vincent Capt. M. Sorsbie W. C. A. N. Francombe A. Watkins	C GM DGM ChEn	3 Douglas DC-3s 15 Lockheed "Lodestars" 4 D. H. "Doves" 6 D. H. "Dragon Rapides" 28	19,824 miles 31,904 km
50	**DETA** Divisao de Exploracao dos Transportes Aereos	1937	State operation	G	Lt.-Col. Pinho da Cunha	M	3 Douglas DC-3s 2 Lockheed "Lodestars" 1 Lockheed 14 5 D. H. "Dragon Rapides" 6 Miscellaneous 17	2,143 miles 3,449 km
	NEAR & FAR EASTERN AIRLINES							
51	**Cyprus Airways Ltd.**	1947	A: £250,000 I: £125,000	44.5 % BEAC 20 % G 35.5 % P	Cdr. V. Wolfson James A. Vick D. J. Platt	C MD CM	5 Douglas DC-3s	2,800 mi. approx. 4,500 km approx.
52	**CGDT** Compagnie Générale de Transports (Lignes Aériennes Libanaises)	1945	I: £500,000	P	Basil Meguerdiche I. Champaloux	P OM	3 Douglas DC-3s 2 Junkers Ju 52s 5	3,476 miles 5,595 km
53	**Iraqi Airways**	1945	State operation O: I. D. 77,500	G	Col. Sabah as Said Col. M. C. P. Mostert Sayid Kanaan al Askari J. E. V. Henty	GM TM CM ChEn	3 Vickers "Vikings" 3 D. H. "Doves" 6	2,408 miles 3,875 km
54	**Air-India International, Ltd.**	1948	A: Rs. 70,000,000 I: Rs. 20,000,000 L: Rs. 5,904,000	49 % G 51 % P	J. R. D. Tata Sir Gurunath Bewoor K. J. Bhore A. O. Gazdar S. K. Kooka	C MD GM OM TrM	4 Lockheed "Constellations"	8,551 miles 13,760 km
55	*IOA Indian Overseas Airlines, Ltd. ("Star Line")	1946/1947	Privately-owned	P	J. M. Akhaney	C	1 Douglas DC-4s 15 Douglas DC-3s 15 Noorduyn "Norsemans" 7 Miscellaneous 38	2,500 mi. approx. 4,000 km approx.
56	*Deccan Airways, Ltd.	1945	A: Rs. 8,571,400 I: Rs. 5,571,400 O: Rs. 4,285,700	75 % G 25 % P	P. M. Reddy C. A. Goodey V. K. Reddy	GM, OM ChEn TrM	10 Douglas DC-3s 2 Miscellaneous 12	1,811 miles 2,915 km
57	**Pak Air, Ltd.**	1948	A: Rs. 10,000,000 I: Rs. 5,500,000 O: Rs. 5,100,000	P	Hussain Malik Mahmood A. Haroon D. T. McCarthy T. Bryson	MD AGM OD ChEn	2 Douglas DC-4s 5 Douglas DC-3s 7	2,086 miles 3,357 km
58	**Air Ceylon, Ltd.**	1947	—	G	W. W. Doyle B. F. M. Amerasekera Capt. S. J. P. Fernando W. A. E. Molamure L. B. Thomas	GM CM OM ChEn TrM	2 Douglas DC-4s 3 Douglas DC-3s 5	12,743 miles 20,508 km
59	**PAL** Philippine Air Lines Inc.	1941	A: Ps. 10,000,000 O: Ps. 500,000	53 % G 47 % P	Col. Andres Soriano E. T. Bolton B. L. Anderson	P OM CM	4 Douglas DC-6s 3 Douglas DC-4s 36 Douglas DC-3s 3 Miscellaneous 46	23,100 miles 37,176 km
60	**CNAC** China National Aviation Corporation	1929	I: CN$2,500,000,000 O: CN$ 10,000,000	80 % G 20 % PAA	inoperative			
61	**CATC** Central Air Transport Corporation	1931/1943	I: CNC$20,000,000	G	inoperative			
	AUSTRALIAN & NEW ZEALAND AIRLINES							
62	**BCPA** British Commonwealth Pacific Airlines	1946	A: £A.5,000,000 I: £A.2,000,000 O: £A.1,000,000	50 % Aus. G. 30 % NZ. G. 20 % Br. G.	Captain A. A. Barlow J. H. Bennett J. B. Mills E. V. Wall	GM OM ChEn TrM	4 Douglas DC-6s	9,754 miles 15,690 km
63	**QEA** Qantas Empire Airways Ltd.	1920/1934	I: £A.3,623,000 O: £A. 120,000	G	W. Hudson Fysh H. H. Harman W. H. Crowther T. H. Wright C. W. Nielson	C, MD GM OM ChEn TrM	5 Lockheed "Constellations" 5 Douglas DC-4s 13 Douglas DC-3s 20 Miscellaneous 43	33,000 miles 53,000 km
64	*TAA Trans-Australia Airlines	1946	I: £A.4,370,000 O: £A. 300,000	G	L. J. Brain J. P. Ryland D. D. Laurie J. Chapman	GM AGM TrM OM	5 Convair-Liners 3 Douglas DC-4s 23 Douglas DC-3s 3 Miscellaneous 34	15,000 miles 24,000 km
65	*ANA Australian National Airways Pty., Ltd.	1936	A: £A.1,500,000 I: £A.1,000,000 O: £A. 500,000	P	Ivan Nello Holyman Herbert Fitzgerald Walsh F. Kowarzik John Stubbs L. McK. Johnson	P GM AGM ChEn OM	9 Douglas DC-4s 24 Douglas DC-3s 3 Bristol 170s 2 Miscellaneous 38	20,000 miles 32,000 km
66	**TEA** Tasman Empire Airways, Ltd.	1939	I: £750,000 O: £500,000	G 39 % NZNAC 38 % BOAC 23 % QEA	Sir Leonard Isitt G. N. Roberts Capt. K. A. Brownjohn G. B. Bolt	C GM OM ChEn	4 Short flying-boats 1 Consolidated "Catalina" 5	1,340 miles 2,160 km
67	**NZNAC** New Zealand National Airways Corp.	1946	A: £1,500,000 I: £1,500,000 O: £ 300,000	G	Sir Leonard Isitt F. Maurice Clarke J. S. Hunter J. J. Busch C. W. Labette	C DC GM OM ChEn	13 Douglas DC-3s 10 Lockheed "Lodestars" 9 Miscellaneous 32	7,895 miles 12,705 km

World Aviation Headquarters

World Aviation Headquarters : The Canadian Government-owned International Aviation Building in Montreal, which was built by Canadian National Railways to house the international civil aviation bodies and Canadian domestic airline headquarters.

In the heart of Montreal, almost within the shadow of Mount Royal which dominates the city, stands the latest and greatest testimony to Montreal's becoming a world aviation centre.

This is the $4,000,000 ten-storey International Aviation Building, which was officially opened on June 1st, 1950 and now is the headquarters of the international—and Canadian—aviation organisations.

A few of the tenants engage in business other than air travel. But in the main this is a building for aviation, Canada's fulfilment of her promise to provide a home for the International Civil Aviation Organisation. Tenants include ICAO, the International Transport Association, Trans-Canada Air Lines, KLM-Royal Dutch Airlines, Air France, Canadian Pacific Air Lines and Aero Caterers.

Excavation started in May, 1947, concrete foundations were begun in September, 1947, steel erection in January, 1948. Total cost was $4,000,000. The content of the building is 3,754,000 cubic feet ; rentable area totals 204,100 sq. ft., of which ICAO occupies 91,000 sq. ft., IATA 10,300 sq. ft., TCA 34,000 sq. ft.

Speaking for the Canadian Government when the building was opened, Trade and Commerce Minister Clarence Decatur Howe, who is the Parliamentarian responsible for Canada's government-owned Trans-Canada Air Lines, left no doubt about the way Canada feels about the new building.

He said : "On June 6th, 1946, Montreal was selected as the permanent site of the ICAO Assembly and as the head office of the International Air Transport Association. On behalf of the Government of Canada I stated that no finer tribute had been paid to Canada and that the Government would recognize its obligation to ensure that the work of the organisation is conducted under the most favourable auspices in keeping with its importance. This ceremony marks the official accomplishment of that promise."

Montreal's bilingual Mayor Camillien Houde declared : "Civil aviation holds a position of ever-increasing importance in our modern existence, and it was quite natural that Montreal, the crossroads of ocean transportation, national and international, should aspire to become the symbol in air navigation."

The International Aviation Building forms the first unit of a group of three buildings designed by The Canadian National Railways to dominate the Montreal Railway Terminal area, facing on mid-town Dorchester Street. Each of the three buildings, "International Aviation Building," "Canadian National Railways Office Building," and "CNR Hotel" is designed to express its separate identity. Study of the design of the entire group had to be carried far enough to ensure that the first unit built, the "International Aviation Building," is properly integrated with the project as a whole.

On the ground floor the International Aviation Building houses the Air Lines Terminal. The concourse, 80 feet wide and 200 feet long, accommodates the various air line ticket offices. Directly off the concourse are the necessary passenger facilities and concessions such as rest rooms, soda bar, news stand, stores, etc. From the soda bar a stairway leads up to a restaurant with accommodation for 175 people.

The building is in the centre of the entertainment district, two minutes walk from main department stores and five minutes stroll from the main financial section of Montreal.

On the floor directly beneath the ticket concourse is the passenger departure concourse leading to the covered driveway where airport limousines enter and depart. Communication between these two floors is by escalator. On the lower floor also is the baggage room. Direct connection is provided on this floor to the railway station concourse another floor below. The nine office floors above are occupied by the aviation interests.

The top six floors are assigned to the International Civil Aviation Organisation. The 10th floor is devoted to the large council chamber, measuring 60 feet long by 45 feet wide, with facilities for simultaneous translation to various languages and a series of committee rooms of varying sizes. There is also a comfortable panelled lounge for the use of the delegates of the 58 nations of ICAO.

The remaining five floors of ICAO's space are taken by delegates' offices and technical staffs. The International Air Transport Association occupies the greater portion of the second floor. Trans-Canada Air Lines' head offices occupy the third and fourth floors and part of the second.

Immediately adjoining and connected to the International Aviation Building, the design visualizes the CNR Office Building, providing 350,000 sq. ft. of office space for various railway departments in the form of a 27-storey tower. Adjoining the CNR Building on the west side will be the projected 900-bedroom hotel.

At the street level and one storey above, the International Aviation Building measures 304 feet four inches in length by 83 feet eight inches in width. Above the second floor the width is reduced to 59 feet to ensure the best natural lighting and ventilation for the offices. The exterior is built of stone, with the lower storeys of granite. The framework is steel and concrete, and native Canadian materials have been used to their fullest advantage.

Inside, every requirement of the air traveller was anticipated by the designers. On the east side of the concourse is the large ticket office of Trans-Canada Air Lines. Facing it on the west side are the ticket offices of Canadian Pacific Air Lines and KLM. These companies, together with Air France which occupies general office space at the south end of the concourse, offer accommodation to all parts of Canada, the United States, the United Kingdom and Ireland, and to the European Continent as well as ticketing arrangements to all parts of the world.

Inauguration : Canada's Minister of Trade and Commerce, Clarence Decatur Howe cuts the ribbon to symbolize the official opening of the International Aviation Building. *Left to right* (the names of the two young ladies are unfortunately not available) : C. P. Edwards, Deputy Minister of Transport ; Transport Minister Lionel Chevrier ; Donald Gordon, President of Canadian National Railways, which owns and constructed the building ; Clarence Decatur Howe, Minister of Trade and Commerce ; and Mayor Camillien Houde, of Montreal.

Critical Reflexions on Air Cabotage

BY DR. ALEX MEYER, ZURICH

The oldest problem of international air law, "freedom of the air," continues to claim a place of importance in all discussions of air legislation. One of the most disputed points is the question of how the conception of "cabotage" (inland transportation) can be defined legally, in other words, the extent to which foreign aircraft can be excluded from operating commercially on certain routes on the basis of the sovereign rights of individual nations. We have invited an air law expert to voice his opinions on the legal questions connected with air cabotage because he had thoroughly studied the problem in his book, "Cabotage Aérien," which was published in Paris in 1948. —ED.—

In an article entitled "Sovereignty and Civil Aviation," *Interavia Review* in March, 1947, reported on a mishap which occurred to Manolete, the celebrated Spanish bullfighter, a few years ago.

Manolete, who was scheduled to fight a bull in Barcelona and for that reason had bought a Madrid—Barcelona air ticket, was not allowed to use the Swedish ABA airline's aircraft operating between Madrid and Stockholm, via Barcelona and Geneva, because the Spanish domestic services are the exclusive province of Spanish flag airlines. He then bought a ticket to Geneva, which enabled him to climb aboard the Swedish aircraft, but made it impossible for him to leave the airport at Barcelona. He finally succeeded in getting outside the aerodrome fence through a stratagem, namely by informing the airport people that he would of course continue to Geneva, but since he was extremely keen on seeing Barcelona again he would do so only on the next day. The officials in question were not quite sure whether that, too, was forbidden or not and allowed him to pass through the gates.

*

The international civil aviation agreements now in force grant each nation the right to reserve the carriage of passengers, cargo and mail to its own aircraft, provided that such traffic is carried on domestic routes, i.e., between two points of the national territory. This principle was carried over into the Chicago Convention of 1944 (ICAO) from the Paris Convention of 1919 (ICAN) and the Pan-American Convention of 1928 (Havana Convention).

As in the case of surface shipping, in which traffic between two or several coastal points in one country is called cabotage, this type of air transportation is described as "Air Cabotage." It is generally believed that the word derives from the Spanish word "cabo" and literally means "to travel from cape to cape."

In the meantime, considerable doubts have arisen regarding the interpretation of "cabotage," as I have previously explained in greater detail [1]. Different opinions have been voiced on the question whether carriage between two or several points in a State which is not effected immediately but includes an intermediate landing in foreign territory can still be regarded as cabotage.

[1] Cf. A. Meyer, "Cabotage Aérien," Editions Internationales, Paris, 1948.

The same problem has recently been the subject of a study by *M. W. Sheehan,* Legal Drafting Officer of the International Air Transport Association, which under the title "*Air Cabotage and the Chicago Convention*" was published in the Harvard Law Review (Volume 63, pp. 1157 etc.).

Sheehan distinguishes between four types of cabotage :

1) *True Cabotage,* which is cabotage wholly within a State or within any of its dependencies.
2) *Overseas Cabotage,* which stands for carriage wholly between a State and/or any of its overseas dependencies.
3) *International Cabotage,* meaning carriage from one point in a State or any of its dependencies to another point in such State or dependency with one or more stops for traffic purposes at intermediate foreign points.
4) *International Overseas Cabotage,* which is carriage between a State and/or any of its overseas dependencies, with one or more stops for traffic purposes at intermediate foreign points.

To me it seems that this classification should arouse concern for several reasons, but notably because I do not believe in distinguishing between "true cabotage" and "untrue cabotage." A transport mission is either cabotage, or it is something else.

Apart from that, only the types listed by Sheehan under (1) and (2) can be regarded as cabotage, namely, carriage wholly between two or several points in the territory or under the sovereignty of a single nation without any stops on foreign soil.

The fact that the categories of carriage listed under (2) and (4) between a State and its overseas dependencies can be regarded as cabotage is based on the broad interpretation of the term "territory" in Article 2 of the Chicago Convention. According to this interpretation, a nation's sovereign territory does not include only the national territory of a State but also colonies, protectorates and mandates of a State.

However, since the application of this broad definition of the term "territory" unreasonably expands cabotage and would be no less than an invitation to abuse, it has repeatedly been suggested to limit the definition, so far as cabotage is concerned, by applying it *separately* to each State's national territory and each overseas dependency. The result would be to prevent cabotage between these territories.

As long as the term "territory" must be interpreted according to Article 2 of the Chicago Convention, there is nothing that can be done to prevent the States from regarding air carriage between the mother country and overseas dependencies as cabotage and reserving them for their own flag aircraft.

*

Things are different so far as the types of carriage mentioned by Sheehan under "International Cabotage" and "International Overseas Cabotage" are concerned, in which intermediate stops are made at foreign points.

If the rules governing cabotage were applied also to these categories of carriage, the term "cabotage" itself would lose its entire significance. For, the regulation that cabotage can be reserved to the aircraft operating under any nation's flag was created for the sole purpose of protecting "national carriage" of a State, i.e., carriage wholly within the State's own territory.

Carriage with intermediate stops abroad can never be regarded as "national carriage," but, quite obviously, always is "international carriage." This is very clearly established in Article 1, Paragraph 2, of the Warsaw Convention, which stipulates that international carriage in the spirit of the Convention not only is carriage between two States, but also carriage in which departure and destinations are within one State but are linked via an intermediate point on foreign soil.

To give a State the right to reserve this type of transportation to its own aircraft would be the final blow to any idea of freedom of the air which is extremely restricted as it is.

The important point is not, as Sheehan seems to believe, whether the intermediate stopping point in foreign territory or the final landing point is regarded as the destination in the case of carriage between two points within a state via an intermediate stop abroad. The decisive consideration is that international carriage can never be subjected to the regulations of cabotage.

A flight from New York to London and Boston, which in air transportation is designated as "open jaw trip"[2], will never be able to be defined as "open jaw cabotage," as Sheehan erroneously seems to assume. Similarly, a flight from New York to San Francisco, via India, with dozens of intermediary stops, can never be regarded as "around-the-world cabotage" as Sheehan advocates.

In opposition to Sheehan's prediction, it is highly unlikely that any court will hand down a decision describing such trips as cabotage and therefore reserving them to the aircraft of any individual country.

However, should such court decisions be made nevertheless, this would indicate the necessity of adopting an amendment to Article 7 of the Chicago Convention in order to prevent future interpretations in that sense.

[2] The term "open jaw trip," current in air transportation, is derived from the graphic illustration of such a trip which resembles a partially opened mouth: London (interruption of trip) New York (Departure) Boston (Destination).

A Friend Catches "Sauceritis"

Los Angeles area police and sheriff radios now include broadcast code designations for "flying saucers," and immediate investigation is provided on all saucer reports. Two reports of saucer sightings were made by citizens within one month, both reporting disc-shaped objects darting through the sky a low altitude. *Interavia's* previously sceptical West Coast correspondent, residing in Monterey Park just east of Los Angeles, writes that he has not yet seen a "saucer" but now has joined the ranks of those baffled by eye-witnessing weird sky happenings. He says: "On Friday night, July 28th, attending a play at the Monterey Park (open air) Bowl with my wife and two of our sons I observed through the surrounding trees and at a level below the treetops two brilliant light-green lights, separated, giving the appearance of wingtip lights on a transport approaching or departing, east or west, at a low altitude. My attention was attracted by the fact that both were green rather than one red and one green. Suddenly the lights began mowing rapidly from south to north, as if the 'airplane' began travelling sideways.

A brilliant greenish trail developed, and the lights moved at a fantastic speed across open sky seen between two trees, and descending at an angle of 10 to 20 degrees. The speeding lights were lost to view behind tree foliage. The spectacle was noted by scores in the theatre audience. The shallow angle of trajectory, and the path from south to north, as well as the constant distance of separation of the twin lights, would seem to discount the observation of a meteor. I wish I knew what I had seen..."

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Travelling along the Fringe of Soviet Air Power

BY ***

Those who penetrate behind the Iron Curtain for the first time, travelling along one of the great highways between northern and southern Germany, usually look forward to their first encounter with the soldiers of the Soviet occupation forces with considerable curiosity. But it is only very rarely that they will see more than a vehicle carrying a few officers or a group of military police. Even in the larger towns the uniforms of the occupation forces are much less in evidence than in the West. The Soviet troops stationed in the Eastern Zone of Germany live behind boarded fences, and it has become a rule, carefully observed for very good reasons, not to be too curious.

During the manoeuvre period you may chance to see a convoy of tanks clattering along the secondary roads. They are always of the fast T-34 type, of which some experts state that they are still the best in the world. How many of these armoured vehicles are hidden in the fenced-off forest districts of Thuringia and Mecklenburg nobody knows. Very likely there are enough to form an avalanche if ever a spark should fall into the powder-barrel of international politics.

Whenever you meet those tanks, you can't help thinking of the American soldiers lounging around in Munich or Frankfurt and of their well-cut uniforms and sharply creased trousers, and of the Lockheed "Shooting Star" jet fighters parked in a straight line at Fürstenfeldbruck air base. How long would it take for them to be compressed into the last few European beachheads by the Soviet armoured steamroller ?

Do not think that we are being over-pessimistic. You don't even have to think of Corea. Those who remember the desperate efforts of the German Army to hold up the T-34 tanks will realise the problem.

There is no better means of destroying fast armoured vehicles of the T-34 type than the flying tank-destroyer, the "can-opener" as the British used to call them. Whether rockets or large-calibre cannon are more suitable may not have been decided yet. But such aircraft would have to be developed especially for the job and should not be merely any old fighter bomber. Who would not rejoice in seeing the skies of Western Europe crowded with such aircraft ? Unfortunately, this type of aeroplane does not seem to have been created yet. Everything has been developed since 1945, from the supersonic fighter to the round-the-world non-stop bomber, except the most important item, the winged tank buster.

This is the uneasy feeling which you get on every trip along the fringe of Soviet air

A Russian T-34 tank—the best in the world ?

power between the Elbe and the Oder. And even in this area the skies are not always very tranquil : the vapour trails of Soviet air squadrons on training flights are much more frequent than those along the Rhine. But the potential danger of this air power and the roar of the aircraft engines do not produce the same menacing effect as the clatter of the armoured vehicles' tracks.

*

Fenced-in Air Bases

Behind the line of demarcation, as the border between two worlds is officially described, Soviet airfields are tightly packed. All the aerodromes built during Goering's heyday, down to the very smallest, seem to be in operation again. Many of them have been enlarged since 1945, and all of them have been given longer runways.

But everything connected with Soviet military might is an impenetrable secret. There are few inhabitants of Eastern Germany who have ever set foot on a military airfield of the Soviets in a capacity other than that of a workman employed in the expansion of the fields. Depending upon the kind of airport involved, the fields are hermetically sealed from the outside world miles from the entrance gate. Even the harmless flying training schools are surrounded by high boarded fences. These fences prevent people from looking in, and others from looking out. The photographing of military installations is evidently forbidden in the Eastern Zone, as anywhere else. But it is a definite hazard to carry a camera just anywhere in Eastern Germany. This explains why no pictures of Soviet aircraft any available in the entire Eastern Zone, neither officially nor privately. No one is authorised to photograph even the Berlin-Schönefeld commercial airport, to which regular services are flown. Trespassers would risk a trip to Siberia and free board and lodging for twenty-five years. Incomprehensible ? No, customary.

It should not be imagined that the curtain concealing Russia's air power in eastern Germany has recently become particularly impenetrable for any specific reason. The notorious secretiveness, the insane distrust and the eternal fear of sabotage apply equally to a stocking factory as to any other kind of activity in the Eastern Zone. In effect, the Soviets have nothing to hide of the air forces they have in their Zone, since they are not operating prototypes but merely well-proved first-line aircraft. This equipment has to be flown on occasion and can therefore not be concealed.

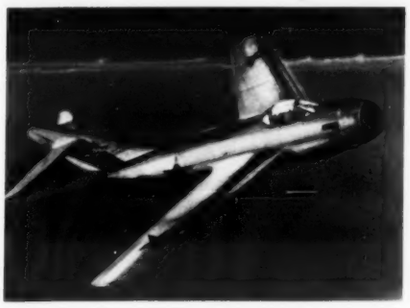
Training Day and Night

One is tempted to conclude that the Soviets are regarding the western advance posts of their air force as a single, huge flying training school. Time and again we will encounter the old bi-planes used for the traing of novices and called "sewing machines," the equivalent of the American "string-bag," by the inhabitants. Training

A Squadron of Petlyakov Pe-2 twin-engined attack bombers.

Tupolev Tu-2 twin-engined light bombers approaching at medium height.

MIG-15



That the MIG-15 turbojet fighter now in service with the Russian Air Force typifies the striking progress made by Russia in the design of jet fighters since the appearance of the "stop-gap" MIG-9 and YAK-15 is shown in the accompanying well-substantiated drawing. Moreover, the type denotes a radical change in Russian design technique, and no doubt it is capable of attaining high Mach numbers. Some of the new fighters flew over Moscow on Soviet Aviation Day in August 1949 and since that time eyewitnesses have reported seeing groups of from 15 to 20 both in Russia and Eastern Germany.

Russia's immediate post-war jet fighters embodied nothing sensational from the design aspect, being of a standard attained by the Germans during 1941-43. The greatest obstacle in the way of the development of high-performance fighters as efficient or superior to those in service with the Western Powers was the lack of a suitable power plant. Having the services of first-class German designers at their disposal, the Russians found that they could produce advanced airframes, but the only propulsive units available (the M-003 and M-004), developments of turbojets that existed in Germany at the end of the War, were notorious for their poor thrust and short operational life. The answer to this problem virtually dropped from out of the blue, for the source from which it was obtained was the last from which Russia anticipated help. The origin of this timely assistance was Britain who supplied the delighted Russians with 55 Rolls-Royce turbojets of the Rolls-Royce "Derwent" and "Nene" types.

Both the "Derwent" and "Nene" are simple centrifugal turbojets, well suited to Soviet mass production methods. In the two-and-a-half years that have elapsed since the importation of these engines, Russian engineers, whose copyist tendencies have become a by-word, are certain to have adapted one or both for home production and have doubtless improved the original output by various means. Reports indicate that the new fighter illustrated here is powered by a Russian adaptation of the "Nene," and the fuselage shape supports this information by suggesting the use of a centrifugal compressor type engine, whereas all known Russian turbojets are of axial-flow type. Russian "Nenes" are quite likely to be giving well over 5,000 pounds static thrust, though periods between overhauls and total life are likely to be set at very nominal figures, again due in part to the methods of quantity manufacture and expectancy of a short combat life.

The new turbojet fighter MIG-15 is of very advanced layout, combining swept-back wings with a sharply swept-back fin and a high-set tail-plane. The fuselage is of good aerodynamic form with an orthodox straight-through arrangement of the jet ducts. The nose ram entry is lipped above to maintain adequate airflow in nose-up position, and the intake ducts bifurcate round the pilot to the plenum chamber aft. The pilot is seated well forward beneath a 360°-vision canopy and, in the version depicted, the armament is installed in the lower portion of the fuselage nose, under the cockpit flooring. This appears to consist of two cannon—probably 20-mm Sh-VAK type, a reliable weapon with a good rate of fire.

A noteworthy feature is the adoption of a high-set cantilever tailplane mounted on a large-area swept-back fin—presumably to avoid broken flow from the cockpit canopy. The tail sweep angle is approximately 20° and should provide adequate longitudinal control at high Mach numbers.

The mid positioned laminar-flow section wing has a strong sweep-back and very little taper. Automatic slots are presumably installed in the leading edge to overcome the poor low-speed lift characteristics of the sharply swept-back wing. It is likely that, as in Russia's wartime fighters, internal equipment and armour have been kept down to a minimum, thus reducing the fighter's wing loading to well below that of contemporary Western fighters, and this feature, combined with moderate span and aspect ratio, should provide high manoeuvrability and good handling characteristics in high "G" turns and pull-outs. Bearing this in mind, the service ceiling is likely to be well in excess of 45,000 feet, and being a combination of one of the best service engines in the world (the Rolls-Royce "Nene") and German "know-how" in airframe design, the new fighter would appear to be a truly formidable opponent.

A conservative performance estimate, based on the layout and assuming 5,000 pounds thrust output, would place the Russian fighter as considerably faster than the de Havilland "Vampire," Gloster "Meteor" and Republic F-84E "Thunderjet," maximum speed possibly being as high as 690 m.p.h. (Mach 0,91), with comparable climb and ceiling, better roll-rate and combat manoeuvrability, lighter weight and inferior range. At medium altitudes it would probably acquit itself well in combat with even the latest versions of the North American F-86 "Sabre" and could almost certainly reach and fight Convair B-36 and Boeing B-50 bomber formations.

A glance over the fences of a Soviet airfield : Ilyushin Il-10 twin-engined light attack bomber lined up ready for take-off.

operations continue without interruption, day and night. Fighter training schools, over which Yak aircraft incessantly engage in tactical exercises and aerobatics, tempt the unitiated to stand and watch. And the aerobatic prowess of the Russians is really worth seeing. They know how to fly, those Russians, with their sky-blue cap-bands.

Perhaps the numerous flying schools prove nothing except that the Soviet forces in Germany are mere occupation troops, the same as all the others, charged with the training of recruits according to their normal formula. Or would it be possible that these schools camouflage an efficient air force ready to go into action at a moment's notice ? The question remains unanswered, for suspicion today has become an inevitable element of every comparison between East and West also among western observers. Unfortunately, or thank heaven : take your choice.

These indefatigably busy flying schools provide much food for thought, however. If such large numbers of pilots are being

trained in the occupied territories, how many schools are in operation in the vast expanses of the Soviet homeland ? Unlimited numbers of pilots are the principal factor in the development of the world's greatest air power.

Nevertheless, it is difficult to discover any members of the Soviet air force in the area between Kottbus and Wismar. This is an inevitable result of the barrier that has been raised between the occupation forces and the German population. Occasional exceptions show the same picture as anywhere else : officers and non-commissioned officers of excellent military bearing, most of them with surprisingly European-looking faces, but all of them without that nonchalance or obvious pride of Western European pilots. The ground crews are perhaps a little greasier.

Live Bombs

It occasionally happens in the German outgrowth of the Red paradise that you are suddenly frightened by the whistle and the explosions of a tactical bombing exercise. This is usually the case in the vicinity of a bombing range, and it reveals the real core of Soviet air power behind the Iron Curtain :

Twin-engined Pe-2 or Tu-2 light bombers, flying in tidy formations of nine aircraft each, approach at medium altitude. Squadron after squadron, they drop their bombs, throwing up dense clouds of dust which obscure the region. They turn and disappear eastwards. A while later they are followed by attack bombers flying at about 3,000 ft., either old Il-2 or Il-10 "Stormoviks" in echelon formation. Diving out of the sun, they approach their practice target, pull up with barking cannon and drop their fragmentation bombs. Two or three times in rapid succession the squadrons attack, new formations constantly join the exercise, and finally they fly off in various directions to return to their bases. Many hundreds of aircraft can thus be seen over a single practice range within a few hours, and there are numerous ranges in the Eastern Zone.

Those who have first-hand knowledge of the Russian-occupied Zone of Germany have had every occasion to see that tactical attack formations giving close support to the armoured divisions form the bulk of the Soviet air forces' combat strength. Heavy bombers are hardly ever seen. On a single occasion, shortly before the Berlin Air Lift period, a number of large four-engined jet bombers flew a menacing demonstration in the course of air manoeuvres in the vicinity of the German capital. More frequent are small formations of old twin-engined Douglas DC-3's probably engaged in the carriage of cargo or paratroops.

High-speed Jet Fighters

As little as a year ago most of the fighters visible in the Eastern Zone were piston-engined fighters, chiefly Lavochkins and Yakovlevs. Jet fighter squadrons then stationed at a few carefully guarded fields flew very rarely and at such great altitudes as to preclude identification.

Today it is the MIG-15 jet fighter* which dominates the skies. It is quite obvious that this type is now being demonstrated for a special purpose. That can be the only explanation for the fact that flights and squadrons are being shown everywhere in the Soviet Zone at low altitude. They have paraded quite openly over the city of Berlin in the presence of Russia's "enemy allies."

The MIG-15 is an imposing fighter, whose aerobatic antics are a joy to watch. Its resemblance to the German DFS-346 experimental aircraft of World War II is striking, and there is hardly any doubt that it is a Chinese copy, though much improved, of the latter type. It has strongly swept-back wings with rounded tips and a narrow, very high-set elevator unit. Experts have estimated its normal cruising speed as at least 620 m.p.h., perhaps 650 m.p.h. The MIG-15 gives the impression of being much faster than the Republic F-84 "Thunderjet." Its manoeuvrability—the writer of these notes has watched it doing aerobatics on several occasions—is astounding. It looks as it if might be the best fighter in the world today, at least the best of those in squadron service in any appreciable number.

Old fighter pilots claim that the MIG-15 is the antidote to the tight formations of four-engined heavy bombers which in the last war doomed the German Me-109 and Fw-190 fighters to failure. Jet fighters like the MIG-15 should be able to disperse bomber formations to such an extent as to eliminate their concentrated fire power.

The Soviet air force has taken good care to provide effective protection for the air space over the forward region of its operating area. The enthusiastic bombing raids of 1944-45 seem to be a thing of the past.

* According to our own sources, the LA-17 fighter also appears to be in service in quantity. —Ed.—

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To Win and to Die

The first bad autumn storms may again descend from the Simplon into the valley and over the Alpine pastures on September 23rd, 1950, as they did 40 years ago, at a time when there was no memorial to Geo Chavez, the man who decided to attempt the first flight across the Alps in spite of the miserable weather.

*

The sacrifice of a man who possesses the means to live an uneventful life in the greatest comfort seems to be of greater value than others prompted by the prospect of material gain.

Geo Chavez was the son of a Peruvian financier and had inherited a vast fortune from his father. Together with his uncle he owned a bank in Lima, which had a branch office in Paris.

At the age of 23, he made an unambiguous decision : "The life of the 'jeunesse dorée' of Paris does not suit me. I must accomplish things."

At the beginning of February, 1910, he enrolled in Farman's flying school. On March 20th of the same year he undertook an "altitude" flight of 1,500 ft.

Geo Chavez (1887-1910).

By the month of August he had won eleven prizes at international air meetings and had crashed twice. On September 8th, he established a new world's altitude record of 2,587 metres. And on September 24th of the same year he lost his life after having accomplished the first crossing of the Alps. He managed to pass the Simplon, but his fuel was running short and he saw that he would never be able to make Milan. He decided on a forced landing near Domodossola, but his aircraft turned turtle at an altitude of 100 meters. Five days later Geo Chavez died of his injuries.

The plaque of the memorial stone that was erected at the take-off point bears the words, "Victory—Death."

Parachuting Pioneers

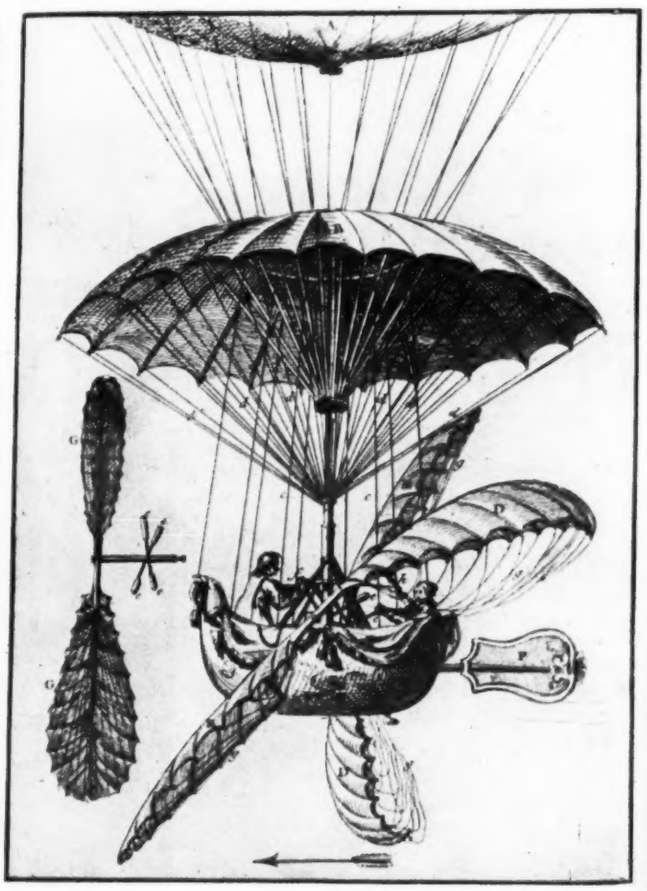
BY SQUADRON LEADER H. R. BUNN, M.B.E., A.R.AE.S., C.M.S.L.A.E.

Some people may be surprised to know that the parachute is not a recent invention—incidentally, the word is a mild misnomer, because it means "prevent fall," and the parachute merely makes falling a little easier and (which is more important) less fatal at its end. Anyway—although Mr. Leslie Irvin early in the present century produced what was in practice the first universally satisfactory parachute, the invention is actually attributed to one Sebastien Lenormand. However, the undoubtedly worthy M. Lenormand was in fact anticipated by the man who seems to have anticipated most ideas in matters aeronautical, the versatile genius Leonardo da Vinci (1452-1519). Without attempting the sacrilege of discrediting either of these gentlemen, the principle of the parachute is so simple that the idea must have occurred to imaginative souls in all ages, and these primitive ideas appear to have been based on the common sea-nettle or jelly-fish, which was regarded as a natural parachute. Be that as it may, a certain Father Loubère, who by the nature of his calling must encourage belief, tells in his History of Siam, published nearly three centuries ago, of a person who frequently diverted the Court by fastening two "parachutes" or large umbrellas to his girdle and "making prodigious leaps" with their assistance. This anonymous person apparently was the ancestor of a long line of exhibition parachute jumpers who, by their own showing, are still making "prodigious leaps."

It was not until 1783 that Sebastien Lenormand demonstrated the practical efficiency of a parachute by making a jump from the top of a high house at Lyons: it is a moot point as to whether this should count seriously in the history of the parachute as we know it, because Lenormand merely regarded it as a useful and original fire escape.

Practical parachute tests began in the 18th Century, but improvisations were successfully used long before that. *Des Maretz* in 1639 published a novel called "Ariane" in which a prisoner held in a Fortress, Mélinte, escaped by using his bed sheet as a parachute *(picture)*. Such escapes actually had taken place, notably by the counterfeiter *Lavin* who succeeded in gaining his freedom from Fort Melians in this manner some time before the publication of "Ariane."

Jean-Pierre Blanchard in 1784 built a balloon which incorporated a parachute to assure the safety of the passengers in case of damage to the balloon.



To Blanchard (1763-1809) must go the credit for adapting the idea for use with balloons : as early as 1785 he had constructed a parachute with basket attached. But Blanchard apparently did not trust the equipment sufficiently to make the first attempt a personal one. He put a dog into the basket, released the parachute, from the balloon at a considerable altitude, and watched his canine "guinea pig" float safely to earth. It is interesting to note that the young Leslie Irvin followed this early tradition in his original experiments with parachutes, but he, being perhaps a dog-lover, used cats, taking advantage of their "nine lives." He carried the affair still further by using a monkey as a partner in his later exhibition parachute descents from balloons.

Blanchard, encouraged by his success, himself ventured a parachute descent from a balloon in 1793, but he was not as lucky as his dog, because, due to some constructional defect, the parachute descended too fast, and he broke his leg on alighting. It would therefore appear that the intrepid aeronaut's first doubts were justified, and there is, perhaps naturally, no record of further jumps by Blanchard, although he continued to be an enthusiastic and successful balloonist. He can, however, claim doubtful fame as being the first man (but by no means the last !) to have sustained injury at the end of a parachute descent.

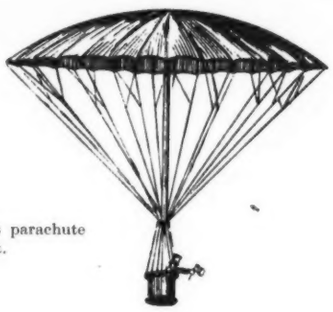
In spite of the claims of Lenormand and Blanchard, the honour of inventing the parachute in a practical and suitable form must go to André Jacques Garnerin. Not only was he the first man to make a *successful* parachute descent from a balloon, but he repeated the feat so often that he was the first to demonstrate the real practicability of the device.

Taken prisoner at Marchiennes in 1793, and confined for nearly three years to the fortress of Bude, in Hungary, Garnerin spent his captivity in mentally elaborating the means of descending by parachute from a balloon—the record does not state whether he was an aeronaut before 1793, or whether his incarceration drove him to "balloonatics." However, on October 22nd, 1797, he made his first public (believed to be his second actual) experiment. He used a large dome-shaped parachute, not unlike an umbrella, made of white canvas and 23 feet in diameter (it is interesting to note the dimensional similarity between this, the first successful parachute, and the 24-foot diameter Irvin parachute, one of the most successful now in general use). At the apex was a truck or disc of wood 10 inches in diameter, with a hole or vent in its centre, attached to the canvas by 32 short lengths of tape. A cylindrical basket, 4 ft. high with a diameter of $2^1/_4$ ft., housed the aeronaut and was suspended from the parachute, which itself was suspended from a hoop attached to the balloon netting. Garnerin ascended from the park at Monceau in Paris, and at a height of about 2,000 feet released the parachute. Relieved of its load, the balloon shot to a great height, where it burst, while the parachute descended very rapidly, with violent oscillations. Garnerin, however, alighted safely upon the plain of Monceau, none the worse for his adventure.

On September 21st, 1802, he performed the first parachute descent in England in the course of a series of balloon flying demonstrations which excited great enthusiasm. The ascent took place from North Audley Street at about six o'clock, and Garnerin released the parachute at about 8,000 feet. The parachute remained in the original collapsed state for several seconds, and the spectators (and, it must be supposed, M. Garnerin) held their breath in suspense, but the canopy suddenly and providentially developed, abruptly checking the speed of fall. The oscillations were so violent that the car, suspended 20 feet below, was sometimes on a level with the canopy ; some accounts state that the oscillations increased, others that they decreased, as the parachute descended, and the latter seems most probable. This early disagreement between observers is, however, typical of many a later drop-test. Garnerin in his basket struck the earth in a field at the back of St. Pancras Church, but all the ill-effects he sustained were a few cuts and slight nausea. The total time of descent was rather more than ten minutes. Garnerin certainly made one other similar descent (this one was

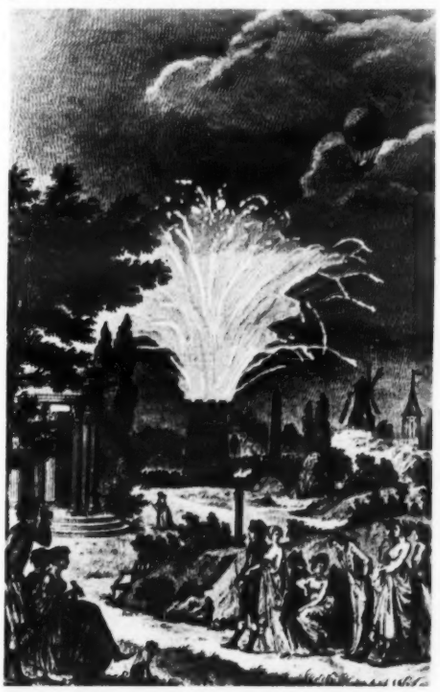
André-Jacques Garnerin was the first to make officially recorded *successful* parachute jumps, in 1797.

Garnerin's parachute during balloon ascent.



Garnerin's parachute in descent.

Garnerin's balloon ascent from Monceau Park, Paris, prior to his parachute descent on October 22nd, 1797.



Robert Cocking's parachute.

described as his third) and several others subsequently on the Continent, but did not repeat his experiment in England.

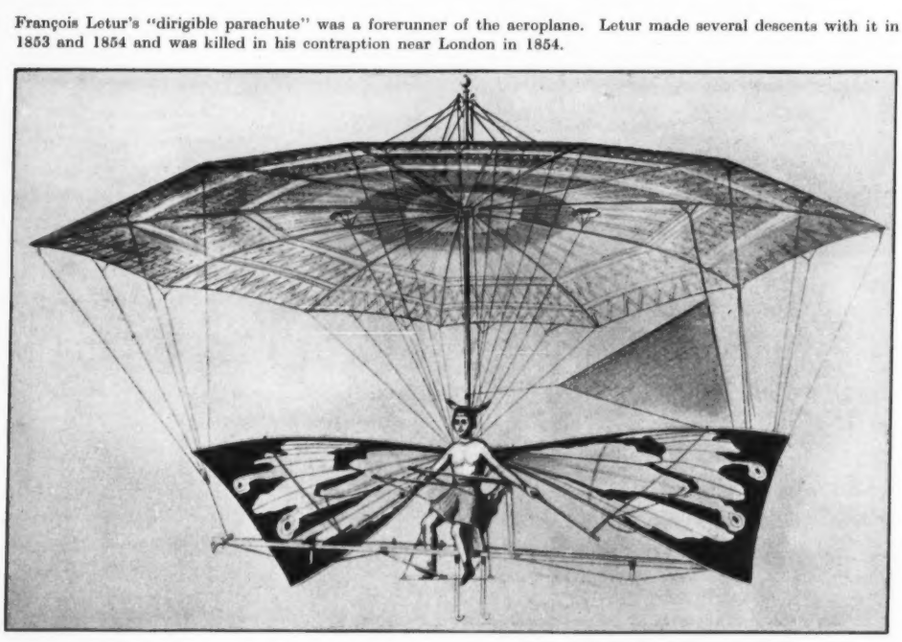
The first person to make an emergency jump with a parachute was a Polish aeronaut, Jordaki Kuparento, who ascended from Warsaw on July 24th, 1808, in a fire balloon. At a considerable altitude, the whole apparatus caught fire, but Kuparento, having thoughtfully provided himself with a parachute, made a descent and landing in safety. In this one venture, he carried on the traditions of both Garnerin and Lenormand, because he had used a parachute both from a balloon and as a fire-escape, though hardly in the manner envisaged by Lenormand.

The next parachute experiment was made in England, and the parachutist, Robert Cocking, made history not because he was the first Englishman to make a parachute descent but because he became the first person known to be killed in doing it. Mr. Cocking was by way of being what later became known as a "balloonatic," and as early as 1814 lectured on parachuting before the City Philosophical Society, and also before the Society of Arts.

Disaster struck Cocking and his parachute on July 24th, 1837. Cocking is the first person known to have been killed in a parachute descent.

Hampton made three descents with a parachute of his own construction in 1839.

François Letur's "dirigible parachute" was a forerunner of the aeroplane. Letur made several descents with it in 1853 and 1854 and was killed in his contraption near London in 1854.

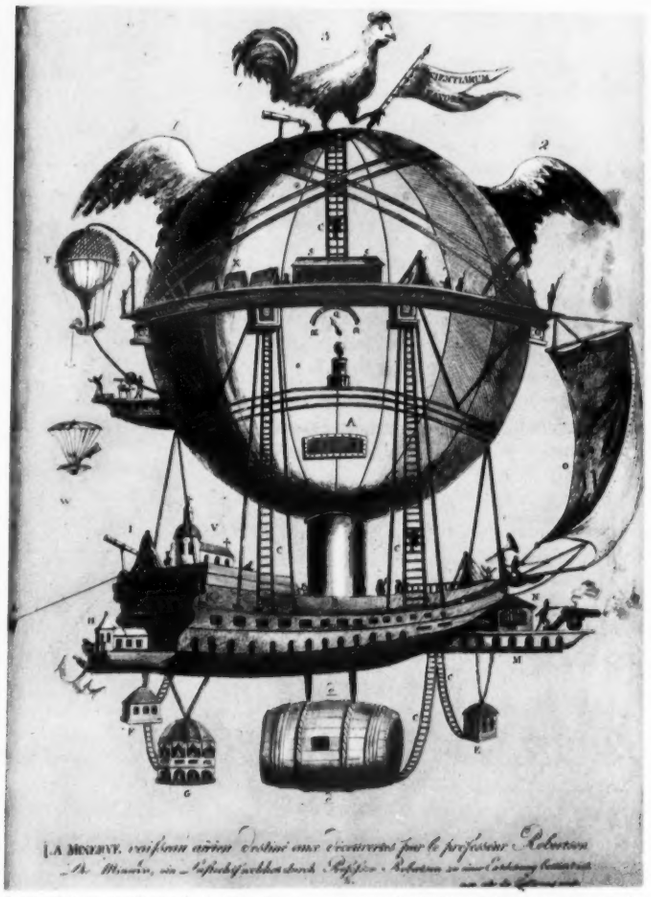


Unlike many other lecturers, Robert Cocking decided to put his theories to a personal test, and constructed his parachute early in 1837—it might appear that he had spent twenty-three years thinking about it. As the great defect of Garnerin's umbrella-shaped canopy was its violent oscillation, Cocking considered that if the parachute were made in a conical, form, vertex downwards, the oscillations would not occur, and if it were sufficiently large, it would present sufficient resistance to check the speed of descent. His parachute was made on this principle with a diameter at its widest part of only 17 feet. The upper rim was made of tin (!) and, although prior announcements gave the total weight as 223 lbs., the evidence at the subsequent inquest showed that the weight was in the region of 400 lbs. As Mr. Cocking weighed 177 lbs., it is hardly surprising that the inquest was necessary.

On July 24th, 1837, the trial took place, ascent being made in a Mr. Green's great Nassau balloon, with Messrs. Green and Spencer as passengers in the car, from Vauxhall Gardens—not, one believes, the first time the balloon had gone up from that delectable spot! Below the balloon car was suspended the parachute basket, with Mr. Cocking as "passenger," and the whole contraption rose, somewhat unwillingly, at twenty-five minutes to eight in the evening. The parachute was carried in the open state, and its resistance and weight made ascent extremely slow and difficult. Cocking had stipulated a release height of 8,000 feet, but when the balloon had struggled to a height of 5,000 feet somewhere over Greenwich, Mr. Green shouted to Cocking that he could not attain the required height if the descent were to be made in daylight. The parachutist accordingly actuated the release catch, and the parachute descended very rapidly with complete stability for a few seconds, until the upper rim appeared to collapse, followed by the collapse of the whole equipment. It took the form of an umbrella, inside-out and nearly closed, and shot earthwards, oscillating violently. The basket broke away about 300 feet from the ground, and Mr. Cocking was found quite dead in a field at Lee.

From this episode there nearly emerged three martyrs to the cause of parachuting, for, not for the last time in history, the crew of the operating machine had narrow escapes from death. On the release of the parachute, Green and Spencer crouched on the floor of the basket and Green clung to the valve-line to release the gas. The balloon shot upwards, plunging and rolling, with gas pouring mainly from the lower valve. The aeronauts had thoughtfully provided themselves with an air-

The first parachute descent to be made in England, as seen by a distinctly imaginative artist. Garnerin made the descent above the Parade Ground, North Audley Street, London, on September 21st, 1802. The balloon, relieved of its load, is drifting away to the left. *(By courtesy, Science Museum, Kensington, London.)*



An ambitious and purely imaginative conception of 1804 for a long-distance, high-endurance balloon which—perhaps naturally—was never constructed. It was intended to carry subsidiary balloons and parachutes, presumably for depositing passengers and troops as the balloon passed over their destination. *(By courtesy, Science Museum, Kensington, London.)*

bag, tubes from which they held in their mouths to prevent gas suffocation. However, for several minutes the gas practically blinded them, and when they came to, the balloon was at an altitude of about four miles descending rapidly. It eventually made a safe landing near Maidstone, but there is no record that Messrs. Green and Spencer ever took part in further parachute experiments, a decision for which they can hardly be blamed in the circumstances.

As usual after the event, many objections were raised to Mr. Cocking's parachute design, but it is almost certain that, if it could have been made of sufficient strength, and larger, it would have answered its purpose, although, of course, its weight would hardly have made it a practical proposition. An American aeronaut, Mr. Wise, who perhaps did not live up to his name, made further experiments with parachutes to the designs of both Cocking and Garnerin, and found Cocking's more stable ; it normally descended in a spiral curve, which would have been disconcerting for paratroop work.

In 1839, a Mr. Hampton became the first Englishman to make a successful descent, and he actually made three descents in a parachute to Garnerin's basic design from his balloon, the "Albion". He also followed Garnerin's example in attaching the parachute to the netting of the balloon, which was left to its own devices on release of the parachute. Being of a more practical or economical turn of mind, however, Hampton adapted the balloon so that it descended automatically soon after the parachute and landed somewhere in the vicinity, to be subsequently recovered and used again. All three descents were made safely, although in one Hampton was severely shaken—one hazards a guess that it was probably the third and last.

Little further work was done until the early 1900's, but the Mr. Wise mentioned earlier noticed that a descending balloon half-filled with gas either rose, or could be manipulated to rise, to the top of the netting in the form of a parachute and thus reduce the rate of descent while dispensing with the need for additional parachute equipment. He on one occasion deliberately exploded his balloon at a good altitude, his improvised parachute descended to the ground, and he made a landing without injury. Similarly, on April 18th, 1863, during one of the scientific high ascents of a Mr. Glaisher, the aeronauts found themselves over the sea at an altitude of about 3,500 feet. The gas was released as quickly as possible and descent made in about four minutes. During the last 2,000 feet or so the collapsed balloon acted as a parachute. The landing shock was, not surprisingly, very severe, and all the instruments were broken, but the occupants of the car were uninjured. They had landed close to the shore at Newhaven, and so at least avoided what later became known as a "water-jump."

Such were the pioneers of parachuting—reading their efforts today may make them appear insignificant and unspectacular, until we remember that these men were also pioneer balloonists. This occupation was in itself sufficiently hazardous, without adding to it the entirely unknown hazards of the parachute, and to these intrepid aeronauts must go the credit for inspiring the innovation of an idea which has proved of inestimable value in modern times.

Air Power Facing the Iron Curtain - III*

Scandinavian Air Defence

COMMON PURPOSE

Two of the four Scandinavian countries are signatories of the Atlantic Pact and one—the most powerful—adheres to the principle of neutrality. The fourth had the bad luck of finding itself next to the Nazi camp during the late war, is situated on the Russian border and is having a hard time keeping the Communists out of its hair without becoming a people's democracy.

In the event of an open clash between the West and the East, all four countries are likely to become involved at an early stage. Defenceless Finland would be overrun as a matter of course and incorporated in the "deployment belt" which runs from the Baltic to within a few miles (and, as a result of Yugoslavia's defection, not to the shores) of the Mediterranean, through the former Baltic nations, Poland and Eastern Germany, Czechoslovakia, Hungary, Rumania and Bulgaria. Norway could offer dozens of potential submarine departure points in her countless fjords and icefree ports. Sweden's mineral wealth and extensive industry would be a worthwhile prize for a warring nation. Denmark possesses neither great industrial resources nor mineral wealth, but she has one thing in common with Sweden and Norway : her airports would be convenient bases for the launching of deadly air attacks against the major western bastion in Europe : Britain. Conversely, a Soviet occupation of these countries would deny the use of vital bomber bases to the western powers.

It is curious, therefore, that Sweden, Norway and Denmark have not seen their way to establishing a joint, integrated system of defence. The explanation is that Norway and Denmark had to learn the hard way that neutrality is no protection against a determined aggressor. Hence, they are seeking safety by collaborating with the Western Allies within the structure of the Atlantic Pact. The attitude of the Swedes is again the result of their World War II neutrality, which in this case paid off.

A Swedish Air Force pilot, correctly dressed in a "G" suit, in front of his "Vampire" jet fighter.

All three countries have one thing in common, namely, the realization that they must concentrate their energy on building up and maintaining strong air defences. The Swedes are making a tremendous effort to expand their air force into a hard-hitting defensive weapon by drawing entirely on their own resources. The Norwegians and Danes, who have no aircraft industry worth mentioning, rely upon purchases abroad and, to some extent, on American aid under the Mutual Defence Assistance Pact.

EUROPE'S THIRD-LARGEST AIR POWER

Conservative estimates credit the *Royal Swedish Air Force* with a strength of between 1,000 and 1,500 first-line combat aircraft, making Sweden the third-largest air power in Europe, behind the Soviets and Britain. Most aircraft are modern, with an increasing number of jet-propelled fighters being delivered from Swedish and British factories. This estimate is based on official information on the organisation of the Air Force and on statements by Government members and others.

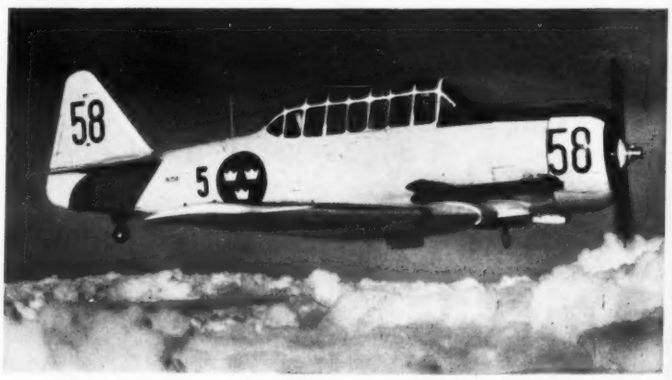
A Swedish Air Force combat wing, of which there are 17 at present (10 day fighter, 1 night fighter, 4 attack and 2 reconnaissance wings), had a pre-war strength or 45 fighters or 36 attacks bombers or reconnaissance aircraft. During the war these figures were stepped up somewhat, although no details are available. The Government now has decided to strengthen Sweden's day fighter force by increasing the number of aircraft per wing by some 50 percent, and it is highly probable that a Swedish day fighter wing is roughly comparable in size to, or may be even more powerful than, a US day fighter group.

Official statements on Sweden's air strength include the speech held early in 1949 by the *Minister of Defence, Allan Vougt,* who said that no less than Kr. 450,000,000 out of a total of Kr. 1,000,000,000 spent on military equipment since the end of World War II had been devoted to the Air Force. Vougt also stated that at least 1,000 aircraft (including trainers) had been delivered to the Air Force during the same period. A major portion of the aircraft now in service was built in Sweden by the SAAB Aircraft Company, the country's principal aircraft manufacturer, which has plants at Linköping and Trollhättan. Another considerable part was procured in Great Britain (the de Havilland "Vampire" repeat order signed by Sweden in 1948 was stated to be the largest export order ever received by the British aircraft industry and according to British reports involved 200 aircraft). Two versions of the "Vampire" are in service, the Mk.1 (Swedish Air Force designation : J 28A) and Mk.50 (J 28B).

* Cf. "Interavia, Review of World Aviation," Nos. 5 and 7, 1950.

The SAAB B-17 dive-bombers are being withdrawn from service with the Swedish Air Force, but form a second-line reserve.

The North American T-6 trainer is in use with the Swedish, Norwegian and Danish air forces.



Other British types are the D. H. "Mosquito Mk.19" (J 30) radar-equipped night fighter, of which 60 have been bought, and the Vickers Supermarine "Spitfire Mk.19" (S 31) reconnaissance fighter, some 70 of which were delivered during 1949. In addition, 50 US North American F-51D "Mustang" fighters (J 26) were delivered during the critical month of April, 1945, which were followed by an additional 90 aircraft of the same type after the war. The first 50 were costly, involving some Kr. 40,000,000, but the next lot of 90 already was war surplus and quite cheap. These J 26s are still in service both for fighter and to some extent reconnaissance duties. They will gradually be replaced by jets, as will be the SAAB-21A (J 21A) pusher and FFVS (J 22) conventional piston-engined fighters, which have top speeds of 400 and 370 m.p.h., respectively.

Swedish-built jet fighters now in service or to be delivered to the fighter wings, include the 500 m.p.h. SAAB-21R (J 21R), a development of the J 21A, 120 of which are said to be on order, and the new swept-wing fighter, the SAAB-29 (J 29), which has an estimated top speed of about 650 m.p.h. (1,050 km/h). Like the SAAB-21R, the SAAB-29 is powered with a British jet engine built under licence. According to recent unofficial Swedish press statements, orders for 500 (!) such aircraft have been signed.

While no less than 11 of Sweden's seventeen combat wings are fighter units, there is also a respectable force of four special attack (previously bomber) wings, equipped with SAAB-18Bs (B 18B), T 18Bs (torpedo-carrying version of the 18B), and the SAAB-21A (A 21). The "18" models are twin-engined tactical bomber aircraft in the 355 m.p.h. (570 km/h) speed category, and the A-21 is identical in most respects to the J 21A fighter and has a 400 m.p.h. (640 km/h) top speed. All attack aircraft carry rockets, bombs and cannon (in the case of the T 18 also a 57-mm. heavy-calibre cannon). A specially designed attack or night fighter aircraft will probably not appear in service prior to 1954, when SAAB-29 production is scheduled to cease.

Reconnaissance duties are carried out by "Spitfires" (S 31), with a top speed of 455 m.p.h., the twin-engined SAAB-18A (S 18), the F-51D "Mustang" (S 26), and the old but faithful Fieseler Storch (S 14).

Special transport units do not exist, but transport duties are carried out by various types of aircraft, including converted 12-passenger Junkers Ju 86K (B 3) twin-engined bombers, Beech C-45s (Tp 45), de Havilland "Doves" (Tp 46) and Noorduyn "Norsemen" (Tp 78).

The Air Rescue Unit based at Hägernäs seaplane base, north of Stockholm, is equipped with Dornier Do 24 and some Convair PBY-5A "Catalina" amphibians (Tp 24 and Tp 47, respectively).

All primary and basic training is carried out at the Flying Training School at Ljungbyhed, Southern Sweden, sometimes referred to as one of the world's largest flying schools, with about 200 trainers (Bücker Bestmann (Sk 25) primary and North American Harvard (Sk 16) advanced trainers). Every year this centre "produces" much more than a hundred new pilots. From the school the pilots go direct to the wings for training on operational aircraft, after which period the officer pilots attend the Air Force Officer Cadet College at Uppsala.

Much work has been done to train the pilots (and prepare the aircraft) for operation in Sweden's Far Northern regions, and every year a detachment from each wing is based in Northern Sweden for winter training. This has provided valuable experience in operating modern aircraft (including jets) in extreme temperatures.

From an organizational point of view, the Swedish Air Force is subject to the jurisdiction of the Ministry of Defence headed by Allan Vougt. However, it has its own Commander-in-Chief (Lieutenant-General Nordenskiöld), to whom report the Air Staff (Chief, Colonel Westring), and advisory Air Board (Chairman, Major-General Nils Söderberg). Directly responsible to the Commander-in-Chief also is the Chief Medical Officer.

The combat organization consists of four Groups, each with three to six operational wings, as follows :

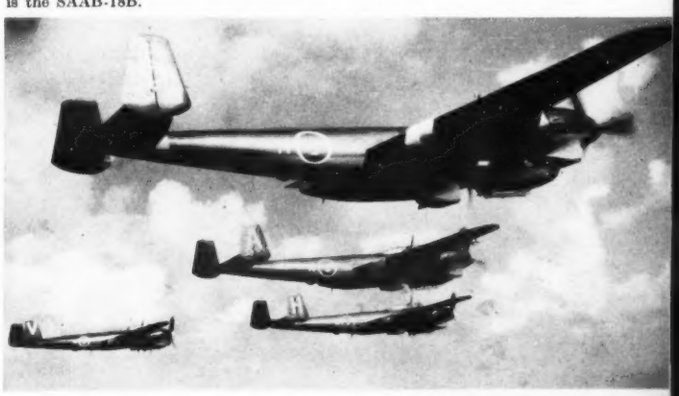
No. 1 Group :	F6	Attack Wing
	F7	» »
	F14	» »
	F17	» »
No. 2 Group :	F4	Day Fighter Wing
	F9	» » »
	F10	» » »
	F12	» » »
	F15	» » »
No. 3 Group :	F1	Night Fighter Wing
	F3	Day Fighter Wing
	F8	» » »
	F13	» » »
	F16	» » »
	F18	» » »

130 North American P-51 "Mustangs" have been bought by the Swedes.

A de Havilland "Mosquito" reconnaissance aircraft of the Swedish Air Force.

The Norwegians use the "Mosquito" as a fighter-bomber.

Sweden's standard attack and torpedo bomber and reconnaissance aircraft is the SAAB-18B.



Norway receives her first four "Vampire" jets . . .

No. 4 Group : F11 Reconnaissance Wing
F21 Air Base Corps and Reconnaissance Squadron
F2 Air-Sea Rescue Unit.

The Technical and Training organization is composed of nine wings reporting direcly to the Commander-in-Chief, as follows :

F5	Air Force Flying Training School
F20	Air Force Officer Cadet College
FKHS	Air Force Academy (Stockholm)
FBS	Air Force Bombardment and Gunnery School (Stockholm)
FCS	Air Force Central School (Västeras)
FRAS	Air Force Radar School (Hägernas)
CVA	Central Workshops (Arboga)
CVM	Central Workshops (Malmslätt)
CVV	Central Workshops (Västeras).

The peacetime distribution of all these units to their bases follows: Västmanlands (F1) night fighter wing at Västeras ; Roslagens (F2) seaplane base at Hägernäsi Ostgöta (F3) day fighter wing at Malmslätt ; Jämtlands (F4) day fighter wing at Ljungbyhed ; Västgöta (F6) attack wing at Karlsborg ; Skaraborgs (F7) attack wing at Satenäs ; Svea (F8) day fighter wing at Barkarby near Stockholm ; Göta (F9) day fighter wing at Gothenburg ; Skanska (F10) day fighter wing at Angelholm ; Södermanlands (F11) reconnaissance wing at Nyköping ; Kalmar (F12) day fighter wing at Kalmar ; Bravalla (F13) day fighter wing at Norrköping ; Hallands (F14) attack wing at Halmstad ; Hälsinge (F15) day fighter wing at Söderhamn ; Upplands (F16) day fighter wing at Uppsala ; Blekinge (F17) attack wing at Ronneby ; Södertörns (F18) day fighter wing at Tullinge ; F19 vacant (this was the number allocated to the volunteer fighter wing in Finland during the 1939-1940 Russo-Finnish war) ; Flygkadettskolan (F20) Air Force Officer Cadet College at Uppsala, and the Norrbottens Flygbaskar (F21) air base corps and reconnaissance squadron at Lulea.

. . . whereas Sweden ordered 500 of her own SAAB J-29 jet fighters . . .

. . . but also uses "Vampires" until further notice.

Minor repair and overhaul is carried out at the workshops of each wing, while major overhaul and repair is undertaken by the Air Force Central Workshops at Arboga (which is housed largely in an underground factory), Malmslätt and Västeras.

At the present time the Air Force costs the Swedish taxpayer about Kr. 300,000,000 a year, which will increase to Kr. 330,000,000 if the suggested 50-percent expansion of the fighter forces is applied to all ten fighter wings. Under present arrangements only six wings are being reinforced in this manner.

No outline of Sweden's air defence system would be complete without a word about her proverbially excellent anti-aircraft artillery. Although still a part of the Army, anti-aircraft artillery command collaborates very closely with the Air Force units. It is almost a platitude to state that the Bofors armament concern has been, and still is, responsible for most of all the outstanding technical achievements made in Sweden during the past decade in the field of anti-aircraft artillery. Bofors guns, operated from land as well as from ships, were used with great success by the Allied forces during World War II. The British, for example, successfully operated the well-known 40-mm Bofors against the German buzz-bombs (V-1) in 1944-45.

In addition to light anti-aircraft cannon of 20-mm calibre type with a firing rate of some 700-800 rounds per minute, Sweden's anti-aircraft defence, as it stands to-day, is made up of 40-mm guns—considerably improved by a 100-percent increase in fire-power (240 rounds per minute instead of the earlier 120) ; a semi-automatic gun of 75-mm calibre firing 20 rounds per minute, and a new 105-mm gun with a ceiling of 35,000 ft. This is the present status.—However, a far-reaching modernization programme, now well under way, provides for delivery of several new and highly effecient guns, as well as more effective control instruments and power operation for all guns down to the 40-mm model. Other recent Swedish developments are proximity and radar fuses for the 105-mm gun and others. Among the new and in some way sensational Bofors anti-aircraft guns the 57-mm gun, which is very effective at heights up to 13,000 ft., is probably to replace the 75-mm gun for field use and airfield defence. While it is somewhat heavier than the "75", the new "57" has a six times greater fire power. Firing 130 rounds per minute, it is power-operated and may be remote-controlled for use against aircraft flying at subsonic and supersonic speeds.—

Lieutenant-General Bengt G. Nordenskiöld, Commander-in-Chief of the Swedish Air Force.

Colonel Gustaf Adolf Westring, Chief of the Swedish Air Staff.

Major-General Paul R. af Uhr, Commander of No. 1 (Attack) Group, Swedish Air Force.

Major-General Folke Ramström, Commander of No. 2 (Day Fighter) Group, Swedish Air Force.

Major-General Axel G. Ljungdahl, Commander of No. 3 (Day and Night Fighter) Group, Swedish Air Force.

Major-General Birger Schyberg, Commander of No. 4 (Reconnaissance) Group, Swedish Air Force.

Bofors has also designed a new 120-mm gun which is effective up to 43,000 ft. with a horizontal range of 21,000 yards. Firing 70 rounds per minute, this fully-automatic heavy-calibre gun is stated to have the same fire power as 30 older guns.

DEFENDING THE FJORDS

Compared with that of Sweden, the Norwegian Air Force is small. Until recently it consisted of about 70 Vickers-Supermarine "Spitfire" fighters, about 25 de Havilland "Mosquitos," and a few other aircraft. In 1948, however, an initial batch of four D. H. "Vampire Mk. 3" jet fighters was delivered. A later order for 36 additional "Vampires" of the new Mk. 52 is now being delivered. The Mk. 52 is similar to the Mk. 50 now in use in Sweden.

The Norwegian Air Force, which in its present form has existed for only six years (previously the Army and the Navy each had an Air Arm of their own) is commanded by *Lieutenant-General Bjarne Oen,* who succeeded the Air Force's first chief General Hj. Riiser-Larsen in 1947. His Chief of Staff is *Colonel Odd Bull.*

In its first post-war configuration, the Norwegian Air Force had six squadrons (Norway has the English nomenclature) with altogether 187 aircraft. A far-reaching reorganisation programme for Norway's defence system is now under consideration by the Government, and these plans will certainly have some effect also on the general organisation of the Air Force.

The plans elaborated by the Defence Committee and submitted to the Government call for the organisation of the following squadrons :

8 day fighter squadrons
2 light bomber night fighter squadrons
2 reconnaissance squadrons
1 transport squadron

As a squadron will have about 20 aircraft (fighters), Norway's day fighter force will total some 160 first-line aircraft at the end of the six-year period specified for completion of the new plans.

Of the financial appropriations, the Air Force will get Kr. 71,500,000, plus another Kr. 18,500,000 for the Anti-Aircraft Artillery Corps, which is a component of the Air Force. Thus, the Air Defence will get Kr. 90,000,000 out of a projected total expenditure of Kr. 300,000,000.

All flying training is carried out at the Gardermoen airfield, which is also used for SAS transatlantic operations. Primary trainers are Fairchild PT-19 "Cornells" and advanced trainers North American T-6 "Texans."

At the end of 1945 the strength of the Norwegian Air Force consisted of the following aircraft : 30 "Spitfires," 10 "Mosquitos," 10 "Sunderland" flying-boats (which were later returned to Britain) ; 3 "Catalinas" and 21 N. A. "Texans" (as well as some "Dakota," Ju 52 and "Lodestar" transports).

During 1946, however, a contract in the amount of £720,000 was placed in England for the supply of the following equipment :

47 "Spitfire" fighters ; 3 "Spitfire 11" reconnaissance fighters ; 18 "Mosquito 6" fighter-bombers ; 5 "Mosquito 3" trainers ; 10 "Ansons" ; 20 "Oxfords" ; in addition, the contract called for quantities of ground equipment, spare parts, spare engines, drop tanks,

A SAAB J-21 pusher fighter of the Swedish Air Force fires its four rockets.

The rocket-carrying J-21 is serviced.

Lieutenant-General Bjarne Oen,
Commander-in-Chief,
Norwegian Air Force.

Colonel Odd Bull,
Chief of Air Staff,
Norwegian Air Force.

Danish "Meteor 7" jet trainers.

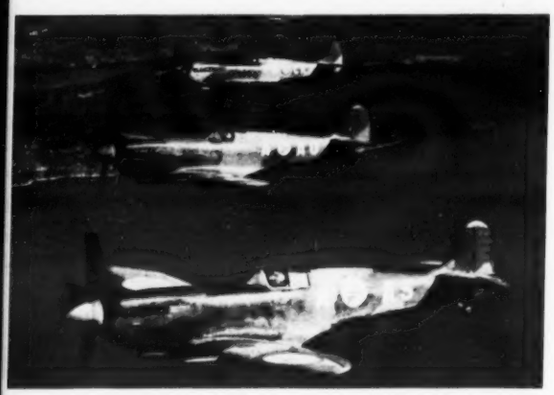
signal equipment, bombs and ammunition sufficient for 12 months of peace-time use plus a two-month war reserve.

Recently Norway rejected a US offer (made under the Mutual Defence Assistance Programme) for Douglas B-26 "Invader" twin-engined bombers but accepted an offer for a squadron of Dakota transports. When turning down the "Invader" offer the Norwegians explained that they would continue operating the "Mosquito" and buy more "Vampires" in Britain.

The following air bases form the surface structure of the peace-time Air Force : Gardermoen, Eggemoen, Forus, Vaernes, Bardufoss, Skattöra. The Forus base will have satellites at Sola-Stavanger and in the form of the Soly seaplane base ; these will have small crews to take care of Air Force communications aircraft. Personnel will be supplied by Forus.

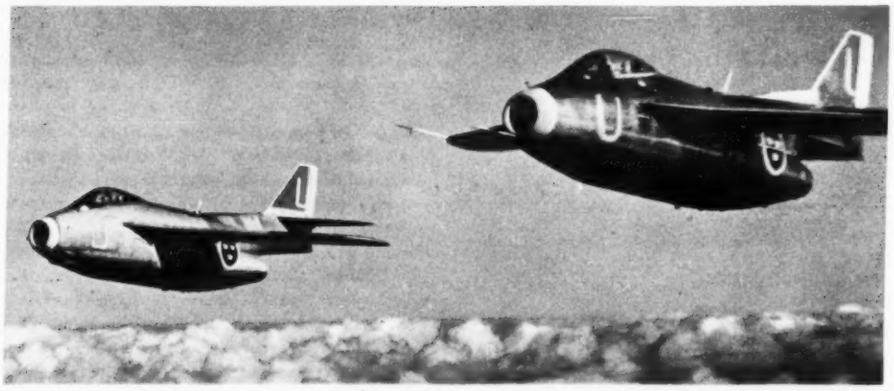
Moreover, it is known that the plans for the creation of two reconnaissance squadrons call for the conversion from "Catalina" amphibians to land-based aircraft. The wisdom of such a decision in a country like Norway, with its long and mountainous coastline can be questioned. It is not known what type of aircraft Norway would choose as replacement for the "Catalina," but possibly this would be some US aircraft under the Arms Aid Programme.

At the age of 59 Lieutenant-General Beugt G. Nordenskiöld, Commander-in-Chief of the Swedish Air Force, still is an active pilot.



"Spitfire" fighters over a Norwegian fjord.

Norway does not possess an aircraft industry capable of producing combat aircraft. The Air Force plans to establish four workshops for the overhaul and repair of the equipment. At present, however, it seems that because of economic reasons only one of these will be activated in peace-time. This shop will serve as a model and central organisation for the other three when they are finally built. This central workshop will be established at Kjeller, the site of the State aircraft factory which was demolished during the war. At present, a workshop is also operated at Horten for the overhaul of the Air Force's seaplanes and flying-boats.



J-29 jets of the Swedish Air Force.

A Norwegian "Vampire" over its home territory.

PROTECTING THE CROSSWAYS

Denmark possesses neither great mineral wealth nor outstanding strategic harbours, but its situation between Central Europe and the Scandinavian Peninsula on the one hand, the North Sea and the Baltic on the other, combined with the suitability of its flat territory for the construction of airfields, would make it extremely valuable as an advanced "aircraft carrier" in the hands of an aggressor whose "strategic" bomber forces are equipped chiefly with medium-range aircraft.

It is only a few weeks ago that, following a prolonged period of indecision and inter-service bickering, a unified Danish Air Force was formed at last by the merger of the former Army Air Corps with the naval air service. The new Commanding General is 59-years-old *Major-General Chr. Forsler*, until recently Danish Military Attaché in Washington. Chief of Air Staff is *Lieutenant-Colonel Kaj Birksted*. The Air Force reports to the Commander-in-Chief of the Danish armed forces, Rear-Admiral Erhard Quistgaard.

In spite of the merger of the two air services, Denmark's air arm is by far the smallest of the three Scandinavian air forces. At the present time its combat force consists mainly of about 40 "Spitfire" fighters bought after the war. However, under a three-year defence expansion plan adopted in 1948, the purchase of 60 British jet fighters was authorized. After protracted negotiations with de Havillands and the Hawker Siddeley Group, a contract for Gloster "Meteor" fighters was awarded to the latter firm. Since Denmark's signature of the Atlantic Pact, the country has been promised the first deliveries for the end of September. Meanwhile, Denmark has taken measures to overcome her difficulties in the training of jet pilots for the new equipment.

Some of her airmen are now undergoing training in Sweden ; in addition, three "Meteor Mk. 7" trainers were ordered and delivered in November of last year.

For elementary training purposes the Air Force has bought 28 de Havilland "Chipmunk" trainers in England for delivery early in 1950. Deliveries started last April. These aircraft are supplemented for basic training by a number of North American T-6 "Texan" basic trainers.

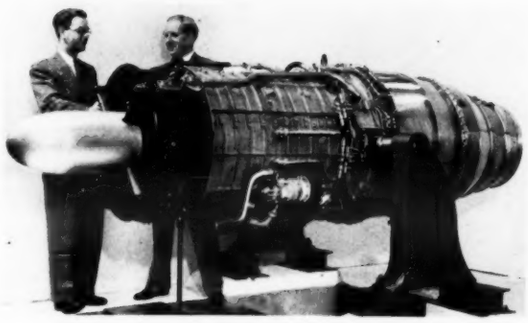
In addition to this modern equipment, the Danish Air Force operates a number of aircraft of miscellaneous types, including Airspeed "Oxford" trainers, Consolidated "Catalina" amphibians, which are used especially for patrol duties from the Danish bases in Greenland, and several Noorduyn "Norseman" utility aircraft.

Denmark also has strengthened her anti-aircraft artillery under the 1948 defence plan by the purchase of sixty of the new Bofors 40-mm A.A. guns.

THREE PEACELOVING NATIONS

This brief outline illustrates that there still exist many gaps in Scandinavia's air defences. Neither Norway nor Denmark could withstand the full onslaught of an aggression from the East. How could it be otherwise ? Neither of the two nations possesses the physical, financial and human resources needed to launch rearmament programmes vast enough to build up their war potential to the required level. Sweden alone could give an aggressor plenty of trouble—for a while. But the three countries together might be able to hold the fort until the arrival of help from the outside.

Progress in Pictures



MORE POWER FOR FASTER FIGHTERS

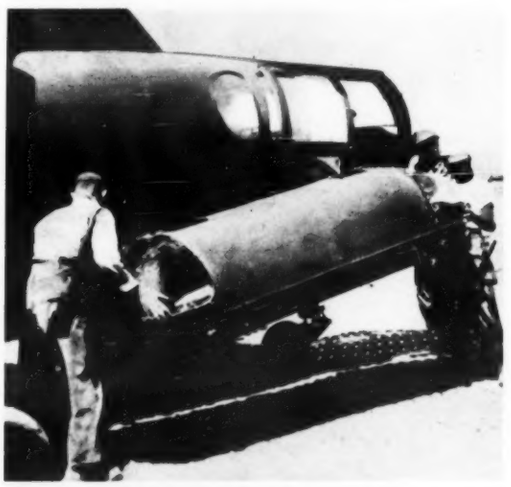
On August 14th, 1950, the first Gloster "Meteor" fighter experimentally equipped with two Armstrong-Siddeley "Sapphire" jet engines, officially the most powerful jets in the world, made its initial flight. The performance of the aircraft naturally is a military secret. But it will be recalled that four years ago (September 7th, 1946) Group Captain E. M. Donaldson set up a new world's speed record of 616 m.p.h. on a Gloster "Meteor 4" powered with two Rolls Royce "Derwent 5" engines delivering a combined static thrust of 7,200 lbs. The new engines produce exactly double that thrust, namely 14,400 lbs., and even more with compressive cooling and afterburning. The pictures show the "Sapphire-Meteor" (WAS 20) and one of its engines which features an axial compressor and annular combustion chamber. H. T. Chapman, Director and General Manager of Armstrong-Siddeley (left) and W. H. Lindsey, Deputy Chief Engineer, may be proud of their latest creation, which has just completed a 150-hour run for its military approved type certificate. Their satisfaction is shared by the designers of Metropolitan Vickers who designed the engine before handing it over to Armstrong-Siddeley for further development and production.

ITALY'S LATEST TRANSPORT

Piloted by Chief Pilot Mario Stoppani, the prototype of the Breda BP. 471 twin-engined medium-stage commercial transport designed by Engineer Mario Pittoni recently made its first flight. The prototype is a freighter powered with Pratt & Whitney R-1830 "Twin Wasp" engines delivering 1,200 h.p. for take-off, but a version accommodating 18 passengers is planned. The inverted high gull-wing design and nose-wheel landing gear made it possible simultaneously to employ low-set cargo or passenger doors and short landing-gear struts and to obtain the best use of the fuselage interior. The aircraft carries 4,900 lbs. of payload over 1,180 miles ; cruising speed is 242 m.p.h. at 60% of METO power at 11,500 ft.

OUTBOARD STRETCHERS

Helicopters like this four- seater Sikorsky operating with the US Air Force in Korea can land and take off in any kind of country. For this reason they are extremely well suited for the carriage of wounded. Two light metal supports for stretchers are fixed to each side of the fuselage outboard of the pilot's cabin. To protect the wounded against the rotor down-draught and the airflow, they are covered with metal canopies equipped with large plexi-glass windows. They enable casualties to be carried from the field station to the next operating room in a minimum of time.



BETTER HULL SHAPES

For two years Goodyear Aircraft Corp. have been running extensive tests on one of their 3-seater GA-2 "Duck" amphibians fitted with a planing-tail type hull. In place of the low and straight step between the forward and tail portion of the hull, an extension resembling the design of an auxiliary float was added. The results have made the effort worth while : shorter take-off run, reduction of the tendencies to porpoise, skip or yaw during take-off or landing.

CSA Ilyushin IL-12B at Prague Airport, 1949.

Russian Workhorse

BY CASSIOPEIA

The Ilyushin IL-12 commercial transport is a rare bird to those of us who live in Western Europe although hundreds of its troop transport version are in service with the Soviet Air Force. Furthermore, in Eastern skies it is becoming as common a sight as a seagull over a fish market.

In the spring of last year I spent hours at the Helsinki Airport in the hope that Soviet Aeroflot service from Moscow would be flown by this type. Each day, however, when the aircraft arrived, precisely on time, it turned out to be the familiar Douglas "Dakota," or IL-2 as the Soviet version is designated. Although it was interesting enough to see this aeroplane with the Aeroflot markings painted on its very spruce and shining olive green camouflage, it still was a familiar type.

Recently, however, CSA, Czech State airline was expecting an extra heavy load of passengers for London, and it was decided to send a larger aeroplane in the form of an IL-12B (with extended dorsal fin) to cope with the heavier traffic. On this occasion not only were we given an opportunity to inspect the aircraft, but also a short flight was arranged so that we could assess its various qualities. The conclusion was that the IL-12B is a very satisfactory replacement for the DC-3.

The IL-12 was designed by the well-known Soviet designer Sergei Ilyushin and went into service early in 1948. In respect of its weight, power and performance it is in the same class as the British Vickers Viking although the seating capacity of the IL-12 is somewhat higher having accommodation for 28-32 passengers.

In appearence the IL-12 is a conventional twin-engined, low-wing, all-metal monoplane with single fin and rudder and fabric-covered control surfaces. It has a fully retractable nose-wheel type undercarriage, with twin wheels on the main units.

The engines are ASH FN of 1,650 h.p., driving four-bladed metal air-screws equipped with fluid de-icing.

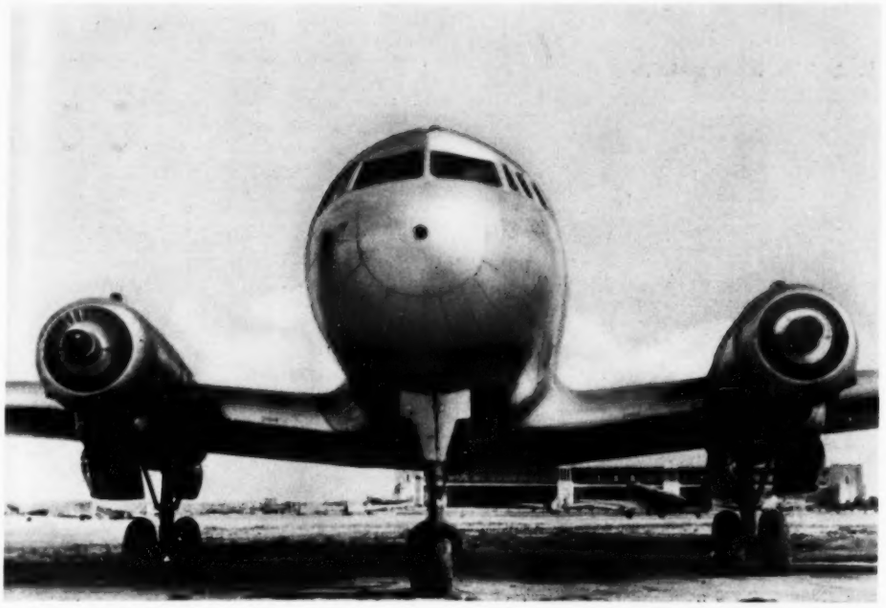
The interior showed the same degree of comfort as other aeroplanes in the same class. The seats were of the adjustable type and were arranged in pairs on either side of the central aisle. In another version of the type there are two seats on one side of the aisle, but only one on the other. The upholstery was of fawn material of good quality and all the chairs had brown leather arm rests with the exception of the four pairs of chairs in the rear. These were slightly narrower owing to the taper of the fuselage. Seat belts were attached but were "safe" in name only being fastened to the chair frames by webbing which had only coarse linen stitching holding it in place and would never have held in an emergency.

The cabin, lined with cream leatherette, was light and well-ventilated and the double-glazed windows were large and rectangular and dressed with yellow silky material.

The seating capacity of the Czech Air Lines' IL-12 is 28 but the front bulkhead is movable to allow the accommodation to be increased by one more row of chairs for which fittings are provided. This provision offers a speedy flexibility between the necessity for carrying passengers or freight. In addition to this forward freight compartment

CSA Ilyushin IL-12B at Northolt Airport, London, 1950. The aircraft seems to have sprouted two additional wireless aerials.

CSA Ilyushin IL-12B : Starboard entrance.



Aeroflot Ilyushin IL-12B—head-on view.

there is a freight hold in the rear of the cabin, to which there is access both from the cabin and through a hatch in the side of the fuselage.

The entrance door to the cabin is on the starboard side of the fuselage, a position common to all Soviet airliners.

The crew's compartment is roomy and almost divided into two "offices." The first and second pilot occupied the usual port and starboard positions, each having flying controls and instruments. Engine and airscrew controls were in the familiar central position between the pilots while the motor instruments were positioned between the two sets of flying instruments.

To the rear of each pilot there is a bulkhead. Behind the port bulkhead was the navigator's compartment while on the starboard side was the radio section. Between and behind the pilots was a flight engineer's "jump seat."

The view for both pilots was extremely good in most directions and the windscreens were equipped for fluid de-icing. This de-icing system is also used for clearing the airscrews, but a hot air system is used for the wings and tail unit.

The crew spoke well of the IL-12's handling characteristics and said it was very like a DC-3 in feel and behaviour.

Unfortunately, our flight in the IL-12 was of fairly short duration, but it was sufficient to ascertain that the noise and vibration level was comfortably low.

The take-off was reminiscent of the "Convair-Liner," the aircraft being pulled into a steep climb. The pilot then showed off its manoeuvrability in a series of very tight turns. The approach was made at about 100 m.p.h. with full flaps. It would have been interesting to see the single-engine performance, but there was not sufficient time or inclination.

The metal skin of the aircraft was covered with a fine film of protective oil which gave the aeroplane a pleasant golden glow. Faintly discernable on the side of the fuselage were the letters CCCP (=USSR), which suggested that this particular aircraft had put in some service in the Soviet Union. In addition, all the legends on the inspection panels were in Russian as were the cockpit instructions and instrument identifications. The passenger instructions were in English, French, Czech and Russian.

The flying technique of the Czech pilot was similar to that experienced on many passenger flights in Finland, namely the steep climb and tight turn on to course. It suggests that the passengers have become accustomed to flying and do not object to the sensations of flight which seem to bring our carefully nurtured passengers near to a state of apoplexy.

The IL-12 has a span of 104 ft. Its length is 69 ft. 11 ins. and the height 26 ½ ft. Empty weight, 24,470 lb. and loaded weight 38,030 lb. The economical cruising speed is 205-210 m.p.h. at 9,800 ft. and maximum speed 252 m.p.h. at 8,200 ft.; range is 780 miles with 32 passengers or 1,240 miles with 27 passengers. The take-off run measures 550 yards and the landing run 350-395 yards.

An Aeroflot Ilyushin IL-12 with accommodation for 24 passengers.

CSA IL-12 at Prague.

Book Reviews

L'Aviation — Aujourd'hui et Demain, by Pierre Lefort, Ingénieur A. & M. — Bibliothèque des Merveilles, Librairie Hachette, Paris, 1950.

The author, who is well-known to readers of *Interavia,* undertakes the task of explaining to the layman the present state of aeronautics and aviation's likely achievements to-morrow. He purposely refrains from mathematical or technical dissertations and merely reviews the various aspects of his subject with great concision, clarity and accuracy : flying equipment, air transportation, engines, special devices, etc., as well as a number of other topical subjects. In this manner he succeeds in painting an overall picture of modern aviation and the problems confronting it. The book give pleasure not only to the layman but also to the expert, because to the latter it furnishes a synthesis of the multitude of details with which he is familiar. (French.) Rh.

Revue générale de l'Air.—Special issue on the occasion of the Aeronautical Congress of the French Union (May 3rd-12th, 1950).—Les Editions Internationales, Paris, 1950.

This special issue of the *Revue générale de l'Air* is a veritable book, and a fat one at that, since it contains more than 650 pages. It is devoted wholly to the work of the Aeronautical Congress of the French Union. It provides an outline of the Union's organisation and a review of all the papers that were read before the various specialised groups. It would not be possible to list even the titles of these papers in a few lines, all of which were read by the most prominent personalities of French aeronautics. It is not necessary to emphasize the great interest of the subjects which were studied and which dealt with every field of aviation. The conclusions arrived at in these papers are of interest not only for France, but are applicable to numerous European countries, especially to those possessing a colonial Empire. (French.) Rh.

Einführung in die Flugtechnik ("Introduction to Aeronautics"), by Dr. H. Rieck.—Industrie- und Fachverlag Bohmann, Vienna, 1949.

In four main parts—functions of the aircraft and its components, theory of flight, aircraft manufacture, pilotage and operation—the author gives a review of all sections of the specialized knowledge required by anyone engaged in some phase of aeronautics. Since the book is designed to be accessible not only to pilots, engineers and engineering students, but also to a wider public interested in aviation, great importance was attached to logical sequence and subdivision of the matter.

The first part describes the components of the aircraft and their functions, the various types of power plant and equipment. The second deals with the elements of the theory of flight and provides a guiding line for the assessment of flying performance and flying characteristics. The third surveys construction materials and working processes employed in aircraft manufacture. The last affords a glance into the practical side of aeronautics, gliding and soaring, powered flight, as well as air safety methods. Useful is a compilation of rough formulae for the calculation of flying performance. Tables of the most current aircraft types, including helicopters, are available in the text. The book contains 93 illustrations, 13 tables and an extensive bibliography. (German.) Ba.

L'Astronautique, by Alexandre Ananoff. — Collection "Savoir," Librairie Arthème Fayard, Paris, 1950.

This is a veritable treatise on interplanetary space travel, in which the author makes a profound study of the various aspects of this future field of human activity. With great objectivity he analyses the numerous proposals put forward by specialists on the subject and separates the ideas which seem practicable from those which appear unfeasible. His style is clear and his work is devoid of mathematics. Graphs and numerous tables contribute to an easier understanding of the text. The work rounds up practically all proposals made in the field of "astronautics" since the end of the 19th Century. *L'Astronautique* by Ananoff is a book of great value which deserves to be studied and pondered by all those interested in space travel of the future. (French.) Rh.

Kleine Raketenkunde, by Hans K. Kaiser.—Mundus-Verlag, Stuttgart, 1949.

Hans K. Kaiser, the founder of the German Society for Interplanetary Research and himself a pioneer rocket engineer, devotes his book, the "Handy Rocket Primer," to the history and the prospects of rocket engineering. His volume forms part of the series "Quellen des Wissens" ("Sources of Knowledge") published by Mundus-Verlag. The chapters dealing with the basic principles, scientific rocket research from its earliest beginnings to its present state and modern types of rocket are written in easily comprehensible form. Numerous illustrations, a small rocket encyclopedia at the end, an index and a comprehensive bibliography complete the text. (German.) Ba.

L'Astronautique, by Lionel Laming. — Collection "Que sais-je ?," Presses Universitaires de France, Paris, 1950.

This little work differs from the other volumes of the "Que sais-je ?" ("What do you Know ?") series for the simple reason that space travel does not yet form part of common knowledge. But the author has succeeded in making a distinction between knowledge definitely acquired and knowledge of a more hypothetical nature. Lionel Laming seeks to cover his subject as a whole without going into many details. The result is a book treating the subject of space travel in a "popularized" manner and making it accessible to everyone. It contains no mathematical or technical considerations, but is characterised by a wealth of extremely graphic comparisons. (French.) Rh.

Raketen von Stern zu Stern ("Rockets from Star to Star"), by Dipl. Ing. Heinz Gartmann, prefaced by Prof. H. Oberth, illustrations by G. Radtke.—Lot-Verlag, Worms, 1949.

Heinz Gartmann, a rocket specialist well-know to our readers, has published numerous scientific treatises in the years gone by. The work before us is not of a theoretical nature, but a popular introduction to the forthcoming "cosmic era" of western engineering. The reader is guided through laboratories and workshops, in which a group of undismayed scientists, engineers and techniciens are feverishly at work building a space ship. He witnesses discussions, successes, setbacks and finally the conquest of this future mode of transport. A novel based on scientific knowledge and reflecting partly dreams for the future and partly present-day reality. (German.) Ba.

Leçons sur la Résistance des Fluides non visqueux.—Volume II.—Edited on the basis of lectures by Paul Painlevé, by Prof. A. Métral and Prof. R. Mazet. Published "hors de série" as part of "Publications Scientifiques et Techniques du Ministère de l'Air." Distribution : Service de Documentation et d'Information Technique de l'Aéronautique, Paris, 1949.

When Paul Painlevé, the successful French mathematician (and not so successful politician) began to read his series of lectures at the Sorbonne in Paris in 1930 on the subject of "The Resistance of Viscous and Non-viscous Fluids" he was 68 years of age and able to look back on 40 years of activity in the teaching profession. Since the first flights of the Wright brothers he had been an aviation enthusiast and sponsor. Joukowski (1904) and other mathematicians of the pioneering age, whose theories he represented, were his contemporaries. The works of Painlevé, which from a mathematical point of view are extremely thorough, have now been published for the use of students. However much this may help to meet a requirement, the purpose might have been served better if the 28 pages of "errata" had been avoided. But more important is the fact that these lectures to-day merely cover a very narrow sector of the field of aero- and hydrodynamics, notably also because only Volume II, which deals with non-viscous fluids, has so far become available. (182 pages ; French.) Ri.

Productifs et Improductifs, by M. P. Guibert.—Dunod, Paris, 1950.

M. P. Guibert, production manager of Société des Avions Marcel Dassault, is well qualified to discuss the subject of productive and unproductive elements in industry. He reviews the problem from the angle of the aircraft industry and from time to time he gives some indication of how his conclusions might be used in other branches of industry. He takes great pains to bring out the fundamental principles, from which he then logically derives a number of rules and criteria, illustrated by practical examples. His work will give many a useful hint to those who are called upon to manage an industrial enterprise, aeronautical or other, for, on the basis of the principles outlined by Guibert they will find it easy to adapt his conclusions to their own special problems. Apart from that, readers interested in industrial organization will be glad to find an objective study of a problem which has long been the object of numerous controversies. (French.) Rh.

Fraumünster-Reiseführer, Band Schweiz, edited by Dr. Eugen Th. Rimli. — Fraumünster-Verlag, Zürich, 1950.

Although this travelling guide devotes only a few almost embarrassed words to air transportation, it merits a brief mention : not because of the attractive wine list on which the whole gamut of Swiss wines, tidily arranged according to their origins, invite you to extend your stay, but because of the praiseworthy attempt to give that class of tourist which finds it difficult to procure the required means in Swiss currency, a handy reference at reasonable cost which is not always available in the more elaborate types of travelling literature. (German.) He.

Atlas international Larousse.—Librairie Larousse, Paris, 1950.

This new atlas, which is published in French, English and Spanish (the three official languages of the International Civil Aviation Organization), has been revised and brought up to date by the inclusion of the latest details. It consists of two parts : (1) Physical and Political, and (2) Economic. The first part comprises 29 maps, including polar projections of the Northern Hemisphere and a number of maps in Mercator's projection for the different countries ; the second part also has 29 maps, of which six are devoted to the air routes of the world, the others to sea and land communications, agriculture, industry, etc. A comprehensive index, indicating place-names in the respective national languages and their equivalent in the three languages of the atlas, and a wealth of statistics established on the basis of latest available figures, a large portion of which supplied by the United Nations, forms the conclusion of the work. This brief summary of the "Table of Contents" is a faint indication of the inexhaustible source of information constituted by the *Larousse International Atlas.* The schoolboy, the businessman and the strategist will all find the information they require. Finally, it should be pointed out that the atlas has been prepared, edited and printed in the great tradition of clarity, accuracy and good finish which have won the Larousse publishing house its world-wide reputation. Rh.

Twenty-Five Men... Twenty-Five Years

The Silver Jubilee of Pratt & Whitney Aircraft Corporation

(Formed on August 2nd, 1925)

A Man Wants To Build Engines

The proverbial wish of the successful middle-aged businessman to junk all his achievements in order to experience for a second time the thrill of gambling everything when one starts from scratch may sometimes be an extremely costly affair. But sometimes it comes off.

At the end of 1924, *Frederick Brant Rentschler,* the then 36-year-old General Manager of Wright Aeronautical Corporation, came to the conclusion that he would never succeed in harmonizing his plans with those of his board of directors. The members of his board were preoccupied chiefly with the design of aircraft, whereas Rentschler had visions of a powerful air-cooled radial engine capable of turning the aeroplane from a plaything of millionaire sportsmen into an instrument exercising control over the world. The broad-shouldered First-Lieutenant of World War I was not in the habit of wasting much time on dreams. He resigned from Wright Aeronautical Corp. which he himself had helped to found in 1919. With a nucleus of twenty-four former Wright employees he moved to East Hartford, in Connecticut.

Did he overestimate the capacities of his collaborators ? He had confidence in the ability of George Mead, a young mechanical engineer who had joined him after having obtained the highest honours at Massachusetts Institute of Technology ; in Donald Brown ; in Andrew Van Dean Willgoos, a designer who was reputed to have great intuition and whom Rentschler had selected for the job of Chief Engineer for Pratt & Whitney Aircraft. Practical experience had to answer the question. Rentschler himself had stated that their new engine "had to be better than its competitors, and we had to prove this in the air."

The twenty-five men did furnish this proof. Five months after their factory had started operations they completed the 400 h.p. "Wasp" engine—the first link in that long chain of aircraft engines without which modern commercial air transportation and military aviation would be unthinkable.

As early as 1932 the leading aviation yearbook, the British "Jane's All the World's Aircraft," well known for its matter-of-fact attitude towards the products of the aircraft industry, enthusiastically praised the achievements of the young Pratt & Whitney Aircraft Co. :

> "Pratt & Whitney engines are at present credited with 15 world's records for both land and seaplanes. Their popularity has made their commercial application widespread. Not less than seventyfive different types of commercial and military aircraft have been designed around either one or the other of these models, and they are seeing service on more than ninety percent of the air transport lines in the United States. In addition to this, they are in service on airlines operating in Europe, South America and Asia."

These are the civilians who made a decisive contribution to America's victory in World War II by enabling 350,000 aircraft engines to be delivered to the US air forces. They are the personnel of the Pratt & Whitney aircraft engine company at the time of its foundation in 1925. Standing *(left to right)* : C.W. Deeds, C.I. Mead, F.B. Rentschler, G. Gunberg, J.J. Borrup, David Robinson, H. Cudworth, F. Irmischer, W.P. Jones, Anna M. Reardon, Marie Wilkinson. *Seated :* A.V.D. Willgoos, E.A. Ryder, L. Castonguay, R.M. Campbell, D. Jack, W.J. Lavack, C. Peterson, A. Hokanson, D.L. Brown, N. King, P. Treffert. Absent when the picture was taken were : C.J. Marks, E.H. Godfrey, T. Carlisle.

The man who contributed this eulogy to Jane's couldn't have written anything else. A year before, Post and Gatty had piloted their Lockheed-Vega "Winnie Mae," powered with a 550-h.p. Pratt & Whitney "Wasp," safely across the Atlantic and the Pacific. They had flown from New York to Berlin in 24 hours and, in the other Hemisphere, from Chabarovsk in Siberia to Nome in Alaska. In the spring of 1932 the same type of aircraft, equipped with a 425 h.p. "Wasp," had carried the popular Amelia Earhart Putnam from Teterboro, N.J., to London. And shortly before the book had gone to press, on September 3rd, 1932, Major James H. Doolittle, who later became the Commanding General of the US Eighth Air Force in Europe and the Pacific, had set a new world speed record with his "Gee Bee," which again was powered with a P&W "Wasp."

Frederick B. Rentschler, Chairman of the Board of *United Aircraft Corporation,* resigned as General Manager of Wright Aeronautical in 1924 and one year later founded Pratt & Whitney Aircraft at Hartford, Conn.

E. Mansfield Horner, President of the powerful United Aircraft Corporation, the operating branches of which are Pratt & Whitney, the Chance Vought aircraft division, the Hamilton Standard propeller division and the Sikorsky helicopter division.

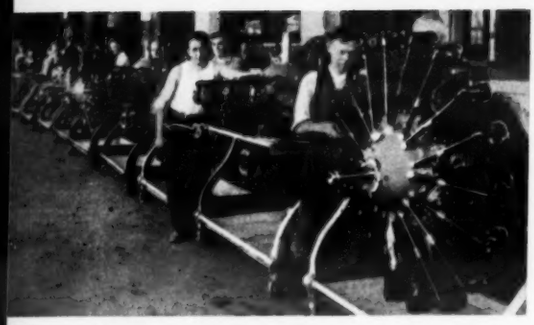
Why not Aircraft, Propellers, Helicopters ?

Meanwhile, the Pratt & Whitney sales staff had not remained idle. The sales figures and the commercial set-up of the company were fully equal to the performance of the company's engines. "Wasps" and "Hornets" had become the standard power plants for the aircraft of the US Army Air Corps and the US Navy. As part of the "Clippers" of Pan American Airways they had helped to establish regular commercial air services on the same ocean routes over which they had previously carried the daring pioneers.

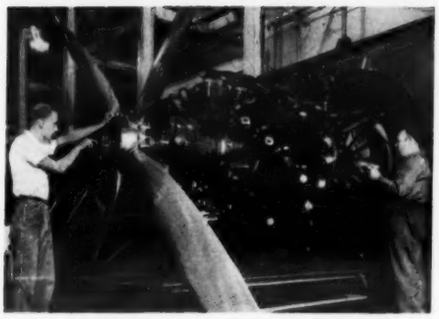
Banks and insurance companies were ready to invest money in the young and flourishing manufacturing concern of Frederick B. Rentschler. The industrial experts of the National City Bank foresaw the coming boom in the aircraft business and paved the way for the consolidation of the Pratt & Whitney engine company with the Chance Vought aircraft concern, the Hamilton Standard propeller company and the Sikorsky company which later became America's leading helicopter manufacturer. From this consolidation emerged *United Aircraft Corporation* (1929), that financially powerful concern of the aircraft industry which was destined to become a corner stone of America's war effort in the air during World War II.

Never Get Excited

In the course of World War II Pratt & Whitney delivered more than 350,000 aircraft engines representing more than half of the horse-power of entire US Air Forces. By the end of the war the "Wasp Major" had



December 1925 : Six months after starting operations Pratt & Whitney produced the 400 h.p. "Wasp," the first air-cooled radial engine of the time. Picture shows a view of the first assembly hall.



Today : The 4,000th "Wasp Major" air-cooled four-row 28-cylinder radial engine of 4,000 h.p. is being fitted with a test propeller for bench tests at East Hartford.

appeared on the scene, an air-cooled 28-cylinder four-row radial engine which then delivered a maximum of 3,500 h.p. Since that time about 5,000 additional "Wasp Majors" have been produced, and the development of the type is still proceeding rapidly. The latest model now being tested has a maximum military output of 4,000 h.p. plus "several hundred pounds" of thrust recovered from the exausts.

The war had ended, commercial air transport planning again became a major concern, the jet-propelled aircraft had been born. One again, people were looking to Pratt & Whitney. Without making any bones about it, the great engine manufactures confessed that they had nothing to sell.

While the British aircraft industry had sacrificed its commercial air transport planning to the common cause of the Allies, Pratt & Whitney had to neglect its preliminary gas turbine development work and abandon its PT-1 propeller-turbine which had started in 1941. It consented to these sacrifices in order to concentrate on the manufacture of reciprocating engines, reciprocating engines and more reciprocating engines for the air forces of the USA. Although the financial situation of United Aircraft was strengthened to such an extent by the huge war-time deliveries that the company was able to overcome the post-war crisis without incurring a deficit (*), the Pratt & Whitney management felt uneasy — and today is ready to admit it.

What should they do ? Remain idle in the hope that something would turn up ? Nothing would have been less like Frederick Rentschler, or Mansfield Horner, or William Gwinn. They decided upon four radical measures, adopted a methodical course of action and— never got excited.

First of all, they informed their shareholders of their plight. In order not to arouse unnecessary alarm, they declared in their annual report at the end of 1945 that, in the management's view, the piston engine would continue to dominate the field for at least another five, possibly even ten years.

But even prior to this declaration, work had started in earnest. The first gas turbine test laboratory had been built rapidly and economically from the power plant of an escort destroyer which had been bought from Navy surplus stocks, dismantled and put together again ashore.

At the same time plans had been established for a large gas turbine laboratory capable of meeting all modern requirements. But the management knew that it would take four or five years before such an installation would be ready for operation.

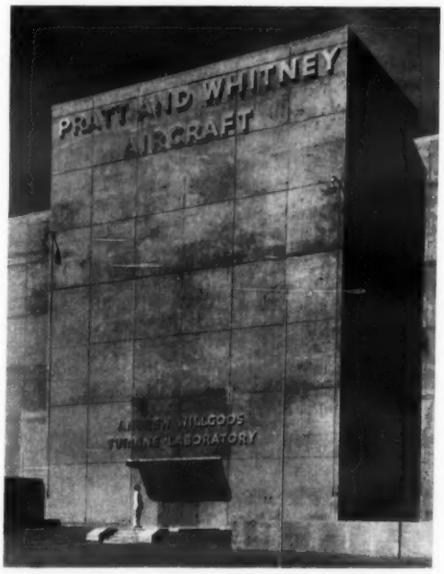
Britain's lead in the field of jet propulsion was undisputed. Frank Whittle had done good work. The arrival in the USA of the first Rolls-Royce "Nene" was eloquent testimony to the high state of development of British jet engine design.

Without false pride Pratt & Whitney did what they had to do. In the summer of 1947 a group of Pratt & Whitney executives led by William P. Gwinn was negotiating in the head office of Rolls-Royce Ltd. A few weeks later they flew back to East Hartford, amply equipped with blueprints, lists of manufacturing materials, handbooks, test instructions and manufacturing rights. By securing the friendly cooperation of one of the largest British gas turbine engine manufacturers, Pratt & Whitney had saved itself the trouble of painfully groping along a trail which had been blazed long ago.

In November, 1948, exactly 16 months after the mission returned from England, the first Pratt & Whitney J-42 "Turbo Wasp" built under the British manufacturing rights was delivered to the US Navy and fitted to the Grumman F9F-2 "Panther" carrier-borne fighter. The more powerful J-48 is based on the designs of the Rolls-Royce "Tay."

Sucessor to the late Andrew V. D. Willgoos is *Arthur E. Smith, Chief Engineer of Pratt & Whitney Aircraft Corp.* Aged 38, he joined the company in 1935 and designed the R-2800 "Double Wasp" which powered a large proportion of America's fighter aircraft during World War II.

An American memorial : Andrew Van Dean Willgoos, the ingenious creator of the Pratt & Whitney engines, died on March 1st, 1949, a day before the Pratt & Whitney-powered Boeing B-50 "Lucky Lady" completed the first non-stop flight round the world. The jet engine laboratory inaugurated in July, 1950, bears his name.



An American Memorial

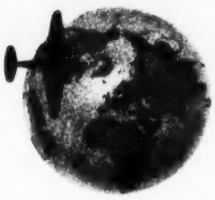
It would be hardly correct to state that silence is reigning about Frederick B. Rentschler today. Pratt & Whitney at present employs 15,206 persons (July, 1950). On a floor area 2,000,000 square feets, no less than 5,300 machine tools are busily at work. But one after the other of the small band of 1925 have left their desks and drawing boards. Mead, Brown and Marks have died. Borrup retired because of ill-health years ago, Earl Ryder still is consulted occasionally on engineering problems. But Rentschler is the only one of the twenty-five who has remained fully active.

"Andy" Willgoos, the ingenious designer of all Pratt & Whitney engines, died of a heart attack on March 1st, 1949, just twenty-four hours before a Boeing B-50 "Superfortress," the "Lucky Lady," completed the first non-stop around-the-world flight ever made. For ninety-four hours its four Pratt & Whitney "Wasp Major" engines had kept it in the air.

On the date of the 25-year jubilee of Pratt & Whitney the memorial to Andrew V. D. Willgoos was dedicated. It is a memorial which hums and roars, the Willgoos Turbine Laboratory, behind whose windowless concrete walls 80,000 h.p. are harnessed for the testing of gas turbine engines and their components. A memorial which cost twelve million dollars... an American memorial.

* United Aircraft post-war profits

	Net profit	*per share*
1945	$12,855,280	$4.35
1946	6,100,000	1.79
1947	9,816,295	3.20
1948	9,423,718	3.05
1949	10,093,182	3.31



What's in the Air? *

THE ALARM HAS SOUNDED

If Soviet Russia's foreign policy of the past few years had pursued the aim of stepping up the speed of the Western defence machine, of encouraging fifty nations of three Continents to consent to greater efforts in the interests of common defence, and of laying the foundation stone of a united Europe, then the Russians could be fairly happy with the results they have achieved. The West has had enough of theories and is beginning to take action.

Weeks before the debate of the new defence appropriations in the Congress, the plants of the American aircraft industry had already adopted speed-up programmes in anticipation of large new contracts.

On July 15th one of the Vice-Presidents of Consolidated Vultee Aircraft Corp., R. O. Ryan, stated that the company's Forth Worth plant would go on two ten-hour shifts as from July 17th to meet B-36 delivery schedules. On the same date the Allison Engineering Division of General Motors announced that it had cancelled the fortnight's vacation shut-down which had been fixed for the beginning of August. Pratt & Whitney and Hamilton Standard, the aircraft engine and propeller divisions of United Aircraft, and Solar Aircraft Company, took identical measures. Boeing Airplane Company cancelled personnel dismissals, and Pratt & Whitney changed over to a seven-day working week.

It is evident, however, that such individual speed-up measures are insufficient to carry out the billion-dollar defence contracts which the Western powers propose to award to their arms industries. Under a centralised leadership the industries of all member nations of the Atlantic and West Pacts must join an integrated programme and submit to at least partial mobilisation in order to meet the extremely urgent deadlines required to establish an effective defence of the West.

*

What are the financial contributions of the individual countries to the common defence effort ?

To strengthen America's defences, President Truman on July 24th requested appropriations totalling $10,480,000,000. Of this amount, the three Services will receive the following sums :

USAF	$4,535,000,000
Army	$3,063,000,000
Navy	$2,648,000,000

The balance of $240,000,000 will be spend for miscellaneous defence purposes. Of the USAF appropriations, $3,423,569,000 will be used for aircraft procurement. Representative Carl Vinson, Chairman of the House Armed Services Committee, on July 27th announced that the USAF's strength will be increased to 58 groups by the middle of 1951 and that the authorized establishment of 69 groups will be attained by the end of 1952.

Field-Marshal Sir William Slim, Chief of the British Imperial General Staff, made an inspection tour to Australia and the Malayan Peninsula at the beginning of July. In the middle of that month he arrived in Alexandria, where he had a brief audience with King Farouk. He then continued to the Gold Coast and inspected the West African Commonwealth defence forces in the company of General Nicholson. At the beginning of August he took part in the West Pact staff defence talks in London. A tight schedule—made possible by the aeroplane.

To cover part of the cost of this programme, President Truman demanded the imposition of additional taxes expected to raise $5,000,000,000, with effect from October 1st, 1950.

These supplementary appropriations are not the only additional burden to be shouldered by the American taxpayer. On August 1st President Truman requested a $4,000,000,000 credit for the Mutual Defence Assistance Progamme ; a few days earlier, on July 26th, he had signed the bill passed by Congress for appropriations of $1,222,500,000 for the same purpose. Finally, the present atomic energy programme is expected to devour an additional $4,000,000,000.

Any harassed taxpayer will understand that the American Government is trying to distribute this load to as many shoulders as possible. In a note to fellow members of the Atlantic Pact the US Government thus asked for information about the additional rearmament measures which each of them would be willing and able to take. The replies, requested by August 5th, show that Europe is beginning to be conscious of her responsibilities.

J. H. Kindelberger, Chairman of North American Aviation Inc., declared at the end of July that in the event of war the USA would not be able to gain air supremacy over the Soviet Union before 1954.

The *British* outlined a whole new armament programme which is to involve £3,400,000,000 spread over the next three years. In other words, it will absorb between eight and ten percent of the entire national income and force the nation back into the "dark age" of wartime austerity. Preliminary measures now envisaged are increased luxury taxes and State-supervision of the clothing industry. A large proportion of the new finance is to be used to reinforce the RAF's fighter formations and to recondition and expand RAF bases neglected since the end of the war.

The *French* pointed out that Defence Minister Pleven had requested defence appropriations of Fr. frs. 500,000,000,000 for the 1951 fiscal year, an increase of Fr. frs. 80,000,000,000 over the preceding year. In addition, supplementary defence expenditures of no less than Fr. frs. 3,500,000,000,000 are scheduled for the next three years.

The *Italians,* who according to Defence Minister Randolfo Pacciardi will increase their armed strength by 70,000 men to the Peace Treaty ceiling of 250,000 men, are considering supplemental appropriations of 50,000,000,000 Lire for the 1950-51 fiscal year to boost the ordinary defence credits of 323,000,000,000 Lire.

The *Danes* will raise their defence expenditure from 2 percent to 3.6 percent of their national income. Incidentally, the *Swedes,* who do not belong to the Atlantic Pact but owing to their geographical situation are in as precarious a position as the other Scandi-

*Based on reports published in "INTERAVIA AIR LETTER," daily international aviation news digest appearing in English and French.

Acts of sabotage in the Royal Navy seem to continue intermittently. In the middle of July some of the gyro instruments of the aircraft carrier "Theseus" (left) were damaged and on August 11th tools were discovered in the boiler system of the aircraft carrier "Illustrious" (right). Meanwhile the "Illustrious" has left for manoeuvres in the Mediterranean. The "Theseus" has sailed for the Korean theatre of operations.

navian countries, are giving priority to their rearmament effort over the entire civilian industrial production. Of interest is, for instance, that the Swedish SAAB Aircraft Company is snowed under with military aircraft contracts to such an extent that they are unable to meet the delivery schedules for the increasingly popular "Scandia" twin-engined medium airliner and are negotiating with the Italian Fiat concern for the production of the type in Italy.

To sum up, it is obvious that the *statistics for the world's rearmament expenditure* recently published in Basle by the Bank for International Payments (1949 annual report) are completely out of date. These figures illustrate the rearmament expenditure by the individual countries in percentages of the national income, as follows :

USSR	12.0 %	Italy	3.8 %
Yugoslavia	11.5	Sweden	3.6
Great Britain	7.4	Switzerland	2.7
Holland	6.1	Belgium	2.5
USA	5.9	Norway	2.5
Turkey	5.8	Denmark	1.9
France	5.0		

*

The world's aircraft industry thus no longer has to worry about where the next contracts will come from. On the contrary, the problem now is to provide the entire arms industry with sufficient raw materials, plant facilities and labour without completely paralyzing civilian production. This problem seems to have been the main point on the agenda of a recent Washington meeting between representatives of seven major Pacific Coast aircraft manufacturers and top Air Force officers. To meet expected requirements, aircraft plants have decided to tabulate all employment applications. As regards the availability of manufacturing space, it is significant that the Sperry Gyroscope Co. is negotiating with the United Nations Organization for the return to Sperry of part of UNO headquarters at Lake Success. The company needs the space to go ahead with increased war production...

The Red Fleet wins our over the Air Force. Naval cadets on parade on the Red Square in Moscow.

In spite of all these efforts there is no doubt that much time will be needed to make good the "errors of omission" of the post-war period. The Chairman of North American Aviation Inc., J. H. "Dutch" Kindelberger, recently expressed his conviction that if war did break out the United States would not be able to gain supremacy in the air over the Russians before 1954... and then only provided there were no heavy bombardments of American plants and no serious sabotage activities.

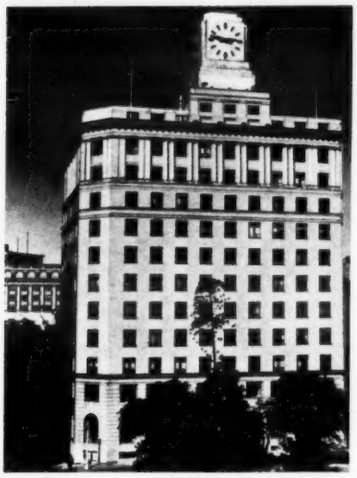
RED FLEET—AIR FORCE DIVISION ?

The weather changed overnight. On July 9th all the stars twinkled in the Moscow skies. Officially it was announced that the annual *Soviet Aviation Day* would be celebrated on July 16th, complete with the traditional air parade over Tushino Airport, Moscow. The participation of Major-General Vassili Stalin, Chief of the Fighter Forces and son of the Soviet Dictator, was assured. Suddenly it happened. The Air Force parade was cancelled because of "unfavourable atmospheric conditions." The atmosphere apparently continued to deteriorate, and instead of parachutists dropping into the picture on the appointed day, the Commander-in-Chief of the Soviet Air Force, Marshal Constantin A. Vershinin, dropped out of it. Moscow Radio casually announced on July 16th that Vershinin, who had held his post since March 20th, 1946, had been succeeded by Colonel-General Zhigarev.

At about the same time it was reported that the appropriations for the Soviet Army, on which depends the Air Force, had been cut by 800,000,000 roubles in favour of the Navy and that the Air Force's strategic bomber units had been transferred to the Navy, together with a number of Air Force bases.

This seems to confirm that, like the USA, the Soviet Union has witnessed a kind of "Pentagon Battle." The decision, however, appears to have been in favour of the Navy. "Stalinist air strategy also provides for long-range independent air force operations," declared Air Force Lieutenant-General Agaltsov in "Red Star" on the occasion of the cancelled Soviet Aviation Day on July 16th. It now seems that the *Navy* will be responsible for these duties.

When, at the beginning of 1950, the construction of a giant aircraft carrier was stopped in the USA and Admiral Denfeld, Chief of Naval Operations, was sent into the wilderness, the angry admirals used to announce the Navy Department on the telephone as the "Naval Division of the US Air Force." One probably is correct in assuming that the Russian Air Force generals who have retained their posts are showing more respect for the State-controlled telephone system.



Whatever the Australien airlines do seems to pay off. Picture shows the headquarters building of the Government-owned Trans-Australia Airlines in Melbourne (left) and of Qantas Empire Airways in Sydney (right).

AIR TRANSPORTATION IN GOOD SHAPE

If it is true that successful business men prefer not to talk about their activities, then the commercial airlines must shroud themselves in impenetrable silence. To tell the truth, they are doing well. Although the picture may still show a number of flaws, their operating figures are rising in leaps and bounds, refuting all the clever predictions that a state of "saturation" had been achieved, notably in the United States, and that further increases in traffic volume were unlikely.

For the first half of 1950 United Air Lines reports a record performance of 650,000,000 passenger-miles, 3,800,000 baggage ton-miles, 12,600,000 freight ton-miles and 5,700,000 mail ton-miles, representing increases of 3½ percent, 30 percent, 15½ percent and 9 percent, respectively, over the same period of the preceding year.

KLM Royal Dutch Airlines carried 187,000 passengers in the first six months of the year, against 178,000 in the preceding year, and simultaneously increased its freight volume from 3,500,000 to 5,000,000 kilogrammes.

British European Airways flew a total of 213,662,462 passenger-miles in the fiscal year to March 31st, 1950, as against 155,027,743 passenger-miles for the 1949 fiscal year.

Northwest Airlines reported a passenger gain of 43 percent in June 1950 over the same month of the previous year, and TWA obtained a passenger load factor of 90 percent on its domestic coach services.

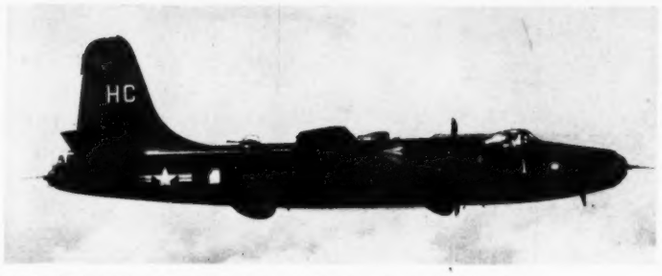
In spite of Korea and the uneasy international situation nearly all IATA member companies will close the 1950 summer season with unexpectedly great increases in their operating figures, and most of them will report operating profits.

On the North Atlantic services alone the IATA member airlines reported an increase from 114,651 passengers to 137,624 passengers in the first six month of 1950 as compared with the first half of 1949.

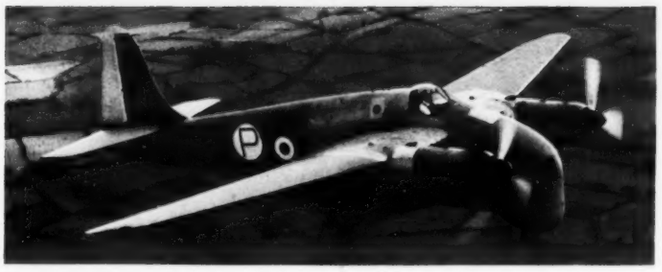
Areas with poor surface communications and long distances naturally continue to contribute a major share to the general increase in the world's airline traffic volume. Acting Civil Aviation Minister R. G. Casey in July quoted figures in support of his claim that Australia leads the world in the amount of flying per head of population. He produced statistics giving the passenger-kilometres flown per million inhabitants in 1949 :

Australia	147,633
Netherlands	80,354
Canada	51,805
Mexico	26,915
USA	19,464
United Kingdom	18,620
Brazil	15,554

Australia indeed is living proof of the fact that air transportation can be profitable. In world air transportation she holds third place. Her State-owned airlines, Trans-Australia Airlines and Qantas Empire Airways, expect substantial profits for the current fiscal years. TAA is anticipating operating revenues totalling £A. 5,000,000, compared with £A. 4,000,000 for the preceding year, notwithstanding the fact that no air mail subsidies are paid in Australia, since air mail is carried at normal surface rates. The privately-owned airline concerns, Australian National Airways, Ansett Airways and the smaller Guinea Airways, also are operating profitably. The air freight business in particular has picked up enormously in recent years (ANA reports a 40-percent increase over last year). Nearly everything the Australian airlines undertake seems to pay off. Air Beef Ltd., a company specializing in the transport of beef from the outback, has been so successful that it inaugurated scheduled flights at the end of July, 1950. Air Beef is a subsidiary of Australian National Airways and operates chiefly between the Glenroy abattoirs and the harbour town



Martin P4M-1 "Mercator" long-range anti-submarine patrol bomber.



The Short S.B. 3 "Harland" carrier-borne anti-submarine aircraft.

of Wynton in North-West Australia. In the 1950 season the company expects to carry a total of 4,500 carcases. An expansion of these operations to Northern Australia at present forms the subject of negotiations.

That the aviation insurers have noticed the fresh breeze blowing through the air transport business is evident. The aviation insurance division of Lloyds succeeded in August, 1950, to close contracts for the first time in history for the insurance of a "complete army." The Turkish Government has taken out an air travel policy covering the Turkish force of 4,500 men that will be transported to the Korean battlefronts by air. The policy insures each officer for $2,800, each non-commissioned officer for $1,400 and each soldier for $280.

FIRST FLIGHTS

On July 27th, precisely a year after the first flight of the first prototype, the *second prototype of the de Havilland "Comet"* four-engined jet-propelled commercial transport aircraft left the ground for the first time. This aircraft, too, was flown by Group Captain John Cunningham, chief test pilot of de Havilland's, who on this occasion celebrated his 33rd birthday suitably in the air. Both prototypes of the "Comet" will be delivered to the Ministry of Supply after they have completed their manufacturers' tests and will then be used for additional flying trials. A.V. Roe and Co. Ltd., hopes to make the maiden flight of the first of the six *Avro "Ashton"* experimental transports in the near future. The Ashton, which is powered with four Rolls-Royce Nene jets, is derived from the "Tudor 8" experimental model and features a nose-wheel landing-gear. Equipped for operation at great altitude, it is likely to attain a maximum speed of more than 400 m.p.h. at 30,000 ft.

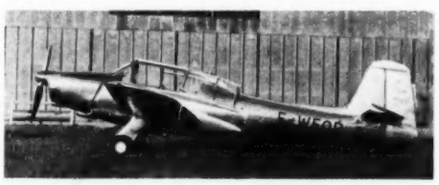
On the other side of the Big Pond the *Fairchild XC-120 "Pack Plane,"* a twin-engined cargo aircraft developed for the USAF, has started its flight tests. The aircraft, which is equipped with a large removable cargo pod, has been described previously in these pages. It has two Pratt & Whitney R-4360-20 "Wasp Major" engines of 3,250 h.p. giving it an estimated top speed of 245 m.p.h. Gross weight is 64,000 lbs.

The Canadians, whose air force is now undergoing a considerable expansion and is being equipped with modern aircraft, have announced the first flight of the *F-86 "Sabre"* fighter built under licence by *Canadair Ltd.* In the USA, the F-86 is being produced in great quantities by North American Aviation Inc. Numerous squadrons of the USAF have already been re-equipped with the type.

BECOMING OPERATIONAL

At the beginning of August the US Navy took delivery of a first series of *Martin P4M-1 "Mercator"* four-engined long-range patrol bomber which it will use for reconnaissance and anti-submarine duties. The power plant arrangement of the type is unusual: each engine nacelle contains a Pratt & Whitney R-4360 "Wasp Major" and an Allison J-33 jet engine mounted in tandem. Futhermore, a small number of *Grumman "Albatross"* twin-engined light utility amphibians, designed for the USAF, the US Navy and Coastguard Units, were delivered. In addition to its three-man crew, the "Albatross" carries either ten passengers or twelve stretcher cases and, if necessary, can be fitted for the carriage of 4,000 lbs. of freight.

Beech YT-34 primary trainer; the aircraft is fully aerobatic.



Morane-Saulnier MS 730 three-seater trainer, from which the MS 732 (retractable landing-gear) has been derived.

TRAINERS

The US Air Force is at present conducting comparative tests with a number of primary trainers. Competitors are the *Fairchild T-31, Beech YT-34* and *TEMCO T-35*. They are being compared with the North American T-6G, a redesigned version of the well-known "Texan" or "Harvard" basic trainer. Although the test schedule is quite comprehensive, which is shown by the fact that it is expected to last several months, the USAF has promised no large production orders for any of the types. The experience acquired in these tests is to be employed in a new design competition for a primary trainer. Details have recently been released the Beech YT-34 (Beech 45 "Mentor"). It is an all-metal low-wing monoplane with a retractable tricycle undercarriage, single rudder unit and two seats in tandem. Powered with a Continental E-225-8 engine delivering 220 h.p. for take-off, it has a maximum speed of 167 m.p.h. at 10,000 ft. on 60 percent power. Gross weight is 2,750 lbs.

NEW AIRCRAFT AND NEW VERSIONS

Shortly after the release of preliminary details of the *Blackburn & General Aircraft Y.B.1* and *Fairey 17* anti-submarine aircraft, both of which are powered with an Armstrong Siddeley "Double Mamba" twin propeller turbine, Short Bros. & Harland Ltd. also announced a new model in this category, the *Short SB.3*. The picture shows a twin-engined mid-wing monoplane with a single rudder unit. Radar equipment housed in the fuselage nose necessitated a not very pretty, trunk-like bulge. Two Armstrong-Siddeley "Mamba" propeller turbines are fitted in the large underslung engine nacelle.

Ateliers d'Aviation Louis Bréguet disclose that two prototypes of the *Bréguet 960* carrier-borne two-seater attack aeroplane are now under construction. The type is to be powered with an A.S. "Mamba" propeller turbine in the nose and a Rolls-Royce "Nene" turbojet in the tail and will be capable of staying in the air for several hours at a most economical cruising speed of 217 m.p.h. Top speed, on the other hand, is said to reach 530 m.p.h. A single-seater land-based version has been developed from the Bréguet 960. It will be known as the *Bréguet 961* and will have the latest "Mamba 3" propeller turbine and "Nene" turbojet.

S. A. de Constructions Aéronautiques Morane-Saulnier have extended their range of training aircraft with the addition of the *Morane-Saulnier MS 732* three-seater low-wing monoplane. The type is a development of the MS 730 and 731 but will have a retractable tail-wheel landing-gear instead of the fixed undercarriage, as well as a more powerful engine.

The first F86 "Sabre" jet fighter built under licence by Canadair made its initial flight from Dorval airport, Montreal, on August 9.

Peeping Tom

The adventurous Capt. Charles "Chuck" Yaeger, first to saunter through the so-called sonic wall (in the Bell X-1 experimental aircraft), now provides what probably is the highest aerial photo ever snapped from an airplane.

Never before has a big city been exposed as nakedly to public view as in this picture of but one section, the western half, of sprawling, congested Los Angeles.

North American Aviation is proud of the photo, being able to boast that it was taken from an RB-45C, the new reconnaissance model of its four-jet B-45C "Tornado" bomber.

Modestly, and for "security" reasons, Captain Yaeger's employer, US Air Force, will say only that it was taken from an altitude of "more than 40,000 ft."

Amongst A-bomb-conscious Los Angeles residents the publication of the picture was received with mixed pride that it was taken from a plane built in their home town and concern over the seeming silver platter offer to Russia of the very latest bomber's view of their city and its targets of opportunity.

We, too, were curious over the latter aspect, and asked a North American executive about it.

Air Force, he said, had cleared the picture of publication. Also, he rationalized, it offered in a different form only a view which any "enemy" might develop from current detail and topographic maps of the area.

A Los Angeles newspaper photographer, one of the best, was asked he thought of the photo. His response was one part professional admiration and nine parts indignation as a citizen of Los Angeles who feels that the Korean affair is too close for comfort :

"In World War II those who rode airliners in and out of Los Angeles did so behind drawn curtains.

"Now we seem to want to show Russia the exact topography of Los Angeles, and give her an excellent photo as an exact reference key to maps she already possesses. For my money it is giving aid and comfort to the enemy.

"Of course, there is a difference. Technically we are not at war with Russia, but with North Korea. So, I guess it makes American sense that we keep on giving Russia such gifts of information right up to the time the shooting starts, if it does come."

Both the North American executive and the photographer offer sound observations. It is Interavia's guess, however, that no harm has been done ; that Air Force, under an increasing tight security policy considered the "aid and comfort" question and decided that Russia knows every bit as much about Los Angeles as the picture can show.

The North American RB-45C "Tornado" four-jet reconnaissance bomber.

1 *Van Nuys :* Large aircraft plant, formerly Lockheed. Baumann Aircraft Corp. is there.
2 *Santa Monica :* Douglas Aircraft Co.
3 *Los Angeles Municipal Airport.* Adjoining, the works of North American Aviation, Inc., makers of the "Tornado" which took the picture.
4 *Beverly Boulevard.*
5 *Hollywood Boulevard.*
6 *Glendale :* Aircraft works.

The Air Hostess Told Us...

BEETLE BATTLE

It is a well-known fact, says our Favourite Air Hostess, that the Russians have invented everything that makes peaceful, modern life possible and enjoyable. These inventions range from the aeroplane and the motor car to penicillin and so on. The Russians also invented the atom bomb, partly with the unofficial help of casually-obtained British and American information. They are now using this gadget for the sole purpose of blasting rocks and mountains from the face of the earth for the construction of electric power and irrigation systems. But centuries ago already, in 1588, they made the world safe for the peace-loving nations by defeating Philip II's Spanish Armada. They did that more or less indirectly, of course, as Professor A. A. Mavrodin of Leningrad University recently explained with commendable modesty, by supplying the English with Russian wood to build their ships, Russian sails, Russian ropes and Russian tar. This, the Professor states, is a convincing demonstration of Russia's technical superiority at an early date and proof of Russia's victory over the Spaniards in the North Sea more than three hundred and sixty years ago. Esmeralda says in this connection that Sir Francis Drake's real name was probably Baron Fedor Drakhov.

But one of the most outstanding discoveries the Russians have made is a new vocabulary for use in connection with delicate diplomatic problems. The discovery dates back to a relatively recent time, namely to the late war, and was copiously applied to the Nazis after 1941 when they had broken the sincere ties of friendship which had sprung up between the two countries as a result of the famous pact of 1939. It is probably due to the relative newness of this terminology that not all echelons of the Soviet Diplomatic Corps have had an opportunity to familiarise themselves with it. What Mr. Malik calls the Nationalist Chinese or the British and Americans at Lake Success may be nobody's business, yet his language discloses that he has only just started learning. The people permanently in Moscow have acquired a much greater dexterity in the use of the vocabulary. In the past few weeks, such hapless creatures as Communist Marshal Tito and Capitalist Americans and Britons have had the honour of being called one or several, or, all, of a long list of endearing epithets : traitor, bandit, rapscallion, scoundrel, blackguard, voracious ape, chattering parrot, deserter, coward, clown, hypocrite, hangman and insolent dwarf.

At the beginning of this summer, the Soviets and their satellites began to throw these sonorous sobriquets especially at the Americans in connection with the latest Russian find, the Beetle Battle. This is the way it came about : the East German Communists one day last June issued an inspired announcement, which was immediately taken up by the Russians, the satellite Poles and Czechs (with appropriate modifications), stating that American aircraft were conducting regular flights over Eastern Germany, Czechoslovakia and Poland for the express purpose of dropping large quantities of Colorado beetles on the potato fields in these regions. The beasts were being jettisoned in boxes and bottles, and considerable quantities of them had been found in streets and on roof-tops. The bug-bombing raids, they proclaimed, were clearly designed to weaken the oh ! so healthy economic situation of these countries. Moreover, bombardment with boxed and bottled beetles even more clearly presaged the full-blown bacteriological battle which was about to be launched by the American warmongers and imperialists and their agents.

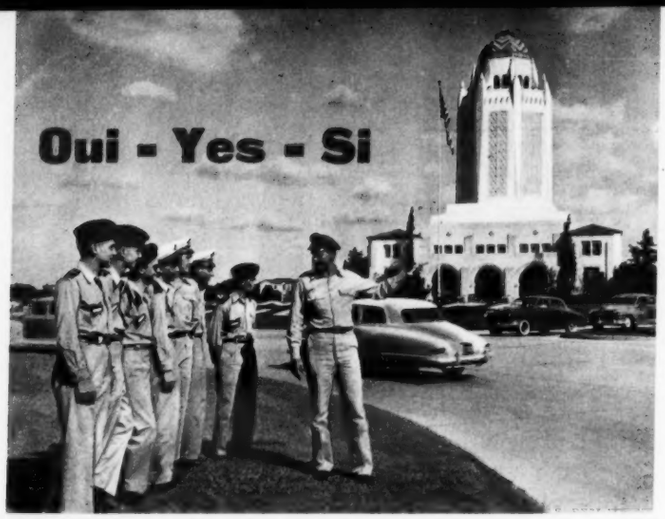
The Russians sent a stiff protest to the US State Department, the Department replied "nuts" in more polite terms, at the same time voicing the suspicion that the Russians had seized upon this "absurd and ridiculous story because they had been unable to protect the satellite territories from being invaded by these insects. High Commissioner McCloy declared in Frankfurt that the Americans would ony be too glad to help the East Germans to combat the pests if they so desired.

Which, Esmeralda says, sounds plausible to her—she is a potato bug expert, you know. Last spring she planted half an acre of potatoes somewhere in Europe and in due course found that the field was bug-infested. Instead of protesting to the Americans, she went to a drug-store and bought some kind of arsenic compound, and next morning the beetles were gone. It was as easy as that. Perhaps, she suggests, the Russians had to launch their Beetle Battle because they had neglected to invent that arsenic preparation. Or perhaps they invented it so long ago that they have completely forgotten about it. Anyway, they have since dropped their bug accusations, probably because they have to concentrate their energy on bringing peace to the U.N. Security Council.

NO TRESPASSING

In spite of such minor disagreements over potato beetles and other kinds of vermin, progress is making headway. America is in the lead, as usual. From Chicago it is announced that man will shortly be able to fly to the moon and other heavenly spots. (Buy the next issue of Interavia Review for full information on the subject.) The Americans are therefore preparing to exploit the new vistas commercially and with customary efficiency. A group of enterprising businessmen, headed by James Mangan, of Chicago, has founded a new nation called "Celestia," whose territory comprises "everything beyond the limits of the Earth." Thus, this latest creation of the American imperialists will certainly be the largest country in the universe. To make sure that nobody else will get there first and claim sovereignty over these stellar bodies, Mr. Mangan has sent a note to the United States Army, Navy and Air Force Departments forbidding them to set foot, ship or aircraft on the territory of the new "country." A similar note was handed to all foreign governments who might covet the "new territories." Finally, in order to make absolutely sure that nobody will jump their claim, the Chicago group of businessmen has registered the new country with the courts of their city and with the United Nations at Lake Success... A bride of heaven is no unusual appearance, says our Favourite Air Hostess, but the stellar stewardess wearing a golden Venus on her bonnet is conceivable only as a result of Esmeralda's authentic report.

Oui - Yes - Si



After their arrival, a USAF officer takes some of the cadets on a "Cook's tour" of Randolph Air Force Base, San Antonio, Texas. The administration building, well-known to pilots of the USAF and of many other nationalities, is in the background.

They were going to America, they were told, to undergo a rigorous flying training course. They immediately settled down to the task of learning the English language with a vengeance. But when they finally arrived at San Antonio, Texas, they were sorry they hadn't learned Spanish as well. Probably they are remedying this deficiency in their hours of leave.

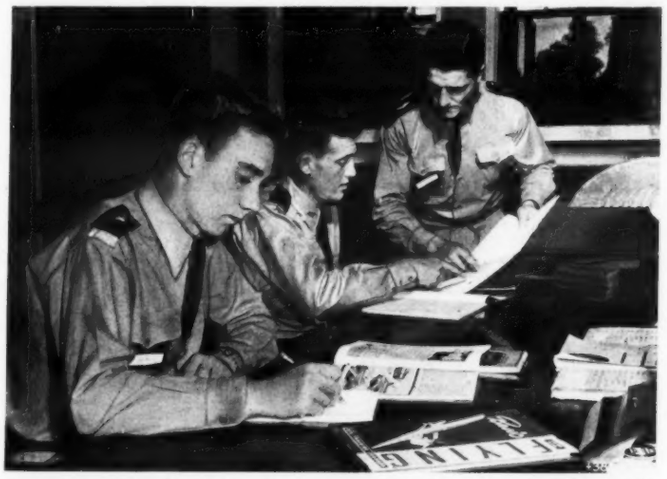
"They" are the seventy-five French air cadets now undergoing training at the United States Air Force Aviation Training School at Randolph Air Force Base, just outside San Antonio, under the provisions of the US Mutual Defence Assistance Programme.

This year, more than 1,300 foreign military personnel are being enrolled at armed forces training schools in the United States and an additional 1,600 at special schools conducted in the European Commands. What the United States is really doing is instructing the instructors—for the trainees have been selected with great care—and, once indoctrinated, they will be able to pass their knowledge on to their own armed forces.

Until June, 1951, voices with strong French accents will therefore be coming over the Air Force radio channels at Randolph Field. Most of the 75 young Frenchmen have had some flying experience, but even with previous flying training they were required to start at the very beginning of the American course—one effect of which has been the rapid elimination of the language difficulty.

The French cadets have no reason to feel lost when they get to San Antonio after the long bus ride from the base. In fact, they are nearly in familiar surroundings.

The French aviation cadets are receiving their flight training in the standard USAF North American T-6 "Texan" basic trainer. Shown here is Air Cadet A. A. Arnodo waving to his buddies. Arnodo had 37 hours military flying time and 12 hours solo time before starting the USAF training course. When the French cadets graduate from the US Air Force flight training school, they will automatically become pilots in the French Air Force.

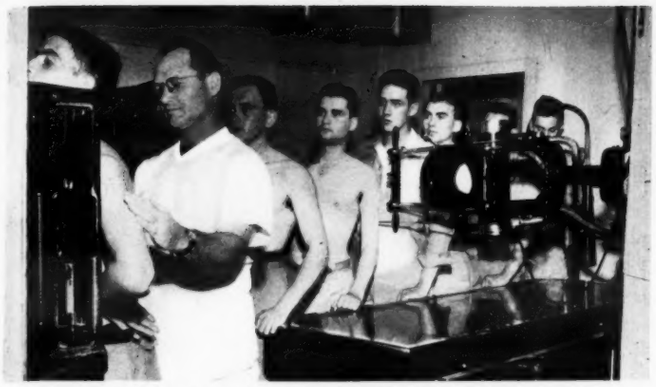


Americans and Frenchmen share the same rooms in the barracks. Facilities provide four men to a room, with desks for study purposes. Shown here are two Frenchmen and one American during their study period. From left to right: Cadets Alain A. Sims, of Rennes, France; Clifford E. Courtney, of National City, California; and H. J. Arnaud of Tain, France.

First day's instruction in the North American T-6. Even though many of the cadets have had previous flight training, they must start at the beginning of the USAF course. Picture shows Lieutenant Lionel Violette, USAF instructor, pointing out instruments and characteristics in the trainer. Cadets are, left to right: A. A. Arnodo, Ronald E. Damerval, Roger R. Cornuche.

One of the outstanding members of the French Air Force team undergoing training is nineteen-year-old Cadet Alain Sims, of Rennes. Sims had only been with the Air Force for four months at the time these pictures were taken, but he had had 25 hours military flying time, 15 hours civilian time, 13 hours solo and 5 hours glider time. He speaks French, English, German and Russian. The average age of the 75 French cadets is 21, whereas the average age for USAF cadets is approximately 23.

Hours of leisure: One of the cadets plays the accompaniment on the piano, the others sing one of their many native songs. But the boys learned "The Eyes of Texas are Upon You" within the first week in the Lone Star State.



Like American cadets, the members of the French Air Force are required to undergo a rigid physical examination before commencing flight training. Shown here is John E. Busby, of Scherty, Texas, placing one of the cadets before the X-ray machine.

After the evening meal, members of both Air Forces gather in the barracks for study. Many of the French cadets, particularly those having little knowledge of English, question their American roommates for a better understanding of English words and phrases. Left to right: Cadets Roger R. Cornuche, of les Lilas, France; D. R. Huffman, of Marshall, Texas; and Pierre M. Bregerie.

All base facilities are available to the members of the French Air Force. Picture shows enlisted personnel with their liaison officer, Captain Alain G. Jourdan, of Paris, France, looking over ties in the cadet post exchange store.

San Antonio is one of the most European towns in the USA and can look back upon a colorful evolution from its Spanish mission days to its present position as the training centre of the USAF.

And the proverbial French charm of the cadets no doubt will have its effect on the dark-eyed belles of San Antonio, who prior to Frenchmen's arrival casually changed over from their Texas drawl into a high-pitched staccato chatter in Spanish. Perhaps they have learned French in the meantime.

The presence of these 75 French airmen at San Antonio indicates that the Americans are taking their Atlantic Pact commitments seriously. For the American assistance programme in addition provides for the training of Belgians, Luxemburgers, Dutchmen, Danes, Norwegians and Italians in the handling of modern Air Force, Army and Naval equipment.

French aviation cadets stand retreat with the US Air Force cadets.

Though wine is not on the menu, the French aviation cadets like the American style of food of which there is, to say the least, an abundance.

Week-end passes are available to all personnel if their academic marks are above passing. Here a group of French aviation cadets is seen leaving the main gate at Randolph Field, eighteen miles from San Antonio, Texas, to which they travel by one of the frequent bus services.

The Cadet Lounge, too, is utilized by both Americans and Frenchmen. Cadets shown here are, left to right: Roger A. Bruno, of La Valette-du-Var, France; Michel Devauchelle, of Fayet, France; R. R. Heyds, of Tucson, Arizona; D. R. Huffman, of Marshall, Texas; and B. J. Gilbert, of Mantes-la-Ville, France, in right foreground.

Turbine Transports of To-Day and To-Morrow

Discussion and fact

Whoever has followed the highly opinionated discussions since 1948 concerning the commercial transport aeroplane of the next ten years certainly has realized that once again the hatchet of war has been dug up by those on the business side and the engineers ; or, if you like, by the financial interests and those with a mission ; between capital and labour.

Airline executives—chiefly Americans, but also a number of Europeans—who at considerable expense had re-equipped their airfleets with new twin- and four-engined aeroplanes, pointed out that certain increases in cruising speed and operating altitude by means of the installation of higher-powered engines should entirely suffice for the coming decade. They would be prepared to accept compound engines and indeed even propeller turbines. Jet-propelled commercial transports were out of the question—"Les jeux sont faits, rien ne va plus !" Needless to say, a number of technical reasons could also be cited in support of these views. Thus it was pointed out that the commercial airports—notably in the USA—are highly congested and that to-day's stacking period and landing procedure, which may involve as much as a whole hour, therefore excludes the operation of jet-propelled types. In addition, jet transports had no effective landing brakes on iced runways, since reversible-pitch airscrews (which at long last are becoming standard equipment) were not available on the jets. Jet transports must fly at considerably higher altitudes than propeller aircraft ; yet, to-day's pressure cabins had not been sufficiently tested for this purpose. And so on, ad infinitum.

In opposition to this, the professional advocates of progress declared that the commercial transports of 1955 should still be utilizable in 1965 ; this would not be the case with airscrew-driven aircraft, at any rate not over medium long stages. Propeller turbines might be perfectly

Trailblazer No. 1 is the Vickers "Viscount" for 40 or 53 passengers, powered with four Rolls-Royce "Dart 3" propeller-turbines, world's first commercial turbine type. The British BEA has ordered 28 of these for their European network. The Armstrong Whitworth "Apollo" medium transport (cf. overleaf) was Trailblazer No. 2.

Trailblazer No. 3: The de Havilland "Comet" long-distance commercial transport for 36 to 48 passengers is powered with four D.H. "Ghost" radial turbines and attains a cruising speed of 490 m.p.h. over a maximum range of 3,540 miles.

Trailblazer No. 4 and rival to the "Viscount" is the Avro "Jetliner" fitted with four Rolls-Royce "Derwent 5" radial turbines, the first inter-city jet transport (40 to 60 passengers).

suitable for continental routes—but for the long-distance schedules of the future, cruising speeds of at least 470 m.p.h. would be indispensable. Finally, could not priority landing clearances—at least at certain hours—be agreed upon for jet-propelled aircraft or special airports be created for long-range traffic ? Apart from that, the operating density at many European, African and Eastern airports was still far from becoming a problem. And the braking effect of the airscrew could be supplanted by braking parachutes in the fuselage tail. The pressure cabins would be continuously improved. Furthermore, flying altitudes of 30,000 to 40,000 feet would certainly suffice for the present, where even the blowing-out of a window would cause no serious danger provided pure oxygen respiration was adopted instantly.

So much for the differences of opinion. A number of engineering experts not only preached : they acted. Certain business groups lent them their aid. Thus, their contribution to the discussion took the form of the *fait accompli :*

For in the meantime, the *Vickers "Viscount"* (four Rolls-Royce "Dart" gas-turbines) accomplished its maiden flight on July 18th, 1948, as the world's first turbine-powered commercial transport type. It is designed for short and medium continental routes. When the prototype had successfully completed its tests, British European Airways on August 3rd, 1950, placed an order for 28 production aircraft. Deliveries are to begin in the autumn of 1952, so that the "Viscount" will go into service on BEA's European routes in 1953. Experimental "Viscount" services were operated a short while ago on the London—Paris route with the prototype : flying time was 1 hour instead of the usual 1 ½ hours. The prototype was also used on BEA's London—Edinburgh route. And on April 10th, 1949, another medium-stage propeller-turbine transport, the *Armstrong Whitworth A. W. 55 "Apollo,"* powered with four A. S. "Mambas," made its first flight.

On July 27th, 1949, the *De Havilland "Comet"* appeared in the skies. As early as October 1949, a first long-distance flight to Tripolis stirred up considerable interest. In March, 1950, a London—Rome round flight took place, each way lasting two hours. And on April 24th, 1950, the London—Cairo 2200-mile route was flown in 5 hours 8 minutes, i.e., in almost half the flying time of a DC-6 or "Constellation," thus proving the suitability of the "Comet" for high-speed long-distance routes. The continuation of the flight to Nairobi on the following day (identical distance and flying time) and the return flight to Hatfield merely served to confirm these results. The British Overseas Airways Corporation has ordered—incidentally, off the drawing boards—fourteen of the type for their Empire routes, of which the first is to be delivered in 1950 and the rest by the end of 1952. In addition, the Canadian Pacific Air Lines placed an order for two in 1953.

And on August 10th, 1949, the Canadian *Avro "Jetliner"* became the fourth member of the trio to band to the air. The representative of an independent design conception and a rival to the "Viscount," it is the first jet-propelled aircraft developed for "inter-city" operations. In April, 1950, the Toronto—New York route of 365 miles was flown in 60 minutes instead of the usual 110. In the near future,

A further pioneer : The large Convair XP5Y-1 long-range flying-boat, fitted with four twin airscrew-turbines and contra-rotating airscrews, serves as an anti-submarine weapon ; during flight, individual engines can be switched off in order to increase endurance.

MANUFACTURER AND TYPE	Category and pass. seats	Power plant and take-off power	DIMENSIONS			WEIGHTS			PERFORMANCE						REMARKS
			span	length	wing area	empty	take-off	landing	cruise speed	service ceiling	pay-load	at range	max. range	t. o. dist.	
			ft. in.	ft. in.	sq. ft.	lbs.	lbs.	lbs.	m.p.h.	ft.	lbs.	miles	miles	yards	
Handley Page "Marathon 2"	feeder 18-22 pass.	2 Armstrong Siddeley "Mamba 1" 2020 h.p. + 615 lbs.	65'0	52'2	498	—	18 000	18 000	255 (10 000')	34 100	5420	500	980	850	not pressurised
Convair "Turboliner"	medium-range freighter	2 Allison T-38 5100 h.p. + 830 lbs.	91,9	74'8	817	—	40 500+	—	310+ (16 000')	(33 000)	—	—	—	—	pressurised cabin ; building
Armstrong Whitworth AW. 55 "Apollo"	continental services 31-45 pass.	4 Armstrong Siddeley "Mamba 2" 5280 h.p. + 1620 lbs.	92'0	72,0	986	27 500	44 800	39 500	305 (20 000')	28 000	7500	820 1)	1050+	1100	pressurised cabin for 25 000 ft.
Vickers Armstrongs "Viscount 701"	continental services 40 or 53 pass.	4 Rolls-Royce "Dart 3" 5600 h.p. + 1180 lbs.	94'0	81'2	963	32 100	51 000	47 500	326 (25 000')	30 000 2) (23 000)	11 400 2700	460 1) 1930	830 2280	1150 2) (1375)	pressurised cabin for 30 000 ft. ; 28 aircraft on order
Avro Canada "Jetliner"	inter-city services 40-60 pass.	4 Rolls-Royce "Derwent 5" 14 400 lbs.	98'1	82'9	1157	—	65 000 or 60 000	52 500	450+ (30 000')	—	10 500 12 000	1000 3) 500 3)	1990	1040 (1180) 2)	pressurised cabin for about + 40 000 ft.
Handley Page "Hermes 5"	intercontinental services 40 pass.	4 Bristol "Theseus" 11 280 h.p. 4)	113'0	96'10	1408	—	90 000	75 000	355 (15 000')	28 500 (21 500) 2)	17 000 8295	2000 3040	3220	1100 (1250) 2)	pressurised cabin
De Havilland "Comet"	intercontinental services 36-48 pass.	4 De Havilland "Ghost 50" 20 000 lbs.	115'0	93'0	2015	—	105 000	—	490 (40 000')	—	8750	2140 5)	3540	—	pressurised cabin for 40 000 ft. ; 18 aircraft on order
Saunders-Roe "Duchess"	intercontinental services 74 pass.	6 De Havilland "Ghost" 30 000 lbs.	135'6	124'6	—	—	130 000	—	(500) (30 000')	—	max. 21 000	—	2000 to 2500	—	projected medium-range flying-boat
Bristol 175 "Britannia"	intercontinental services 62 or 96 pass.	4 Bristol "Proteus" 12 800 h.p. + 3200 lbs.	140'0	114'0	2055	—	130 000	—	(340) (29 000')	—	17 610	2650	5000	(1400)	pressurised cabin ; building
Convair XP5Y-1	military flying-boat	4 Allison T-40 20 400 h.p. + 3320 lbs.	146'0	130'0	—	—	140 000	—	—	—	20 000	4600	—	—	max. speed 350 + m.p.h.
Bristol 167 "Brabazon 1, Mk. 2"	transoceanic services 100 + pass.	4 Bristol "Coupled Proteus" 25 600 h.p. + 6400 lbs.	230'0	178,10	5422	163 000	290 000	—	(330) (35 000')	(40 000)	—	—	5460	—	pressurised cabin ; building
Saunders-Roe SR/45 "Princess"	transoceanic services 105 pass.	4 Bristol "Coupled Proteus" + 2 "Proteus" 32 000 h.p. + 8000 lbs.	219'6	148'0	5100	—	315 000	—	(380) (35 000')	—	22 000	—	5500	—	pressurised cabin ; building

1) Range allowing for 200 nautical miles to alternative airport.
2) Performance on three engines.
3) Range with full ATA allowances (45 mins. stand-off plus 200 miles to alternative airport).
4) Equivalent take-off power of production version (prototype develops only 7900 h.p. plus 2860 lbs. at take-off).
5) Range against 50 m.p.h. head-wind, allowing for 30 mins. stand-off plus 395 miles to alternative airport.

The Handley Page "Marathon 2" feeder aeroplane with two Armstrong Siddeley "Mamba 1" airscrew turbines accommodates 18 to 22 passengers.

Trailblazer No. 2 was the Armstrong Whitworth "Apollo" medium-range transport prototype for 31 to 45 passengers which is powered with four "Mamba 2" airscrew-turbines.

the first prototype will be placed at the disposal of the Trans-Canada Airlines for operational tests ; a second is now nearing completion.

Finally, the first of a series, a very large gas-turbine-powered aircraft for extremely long ranges, which had been building for a long time, accomplished its maiden flight. On April 18th, 1950, the *Convair XP5Y-1 flying-boat* took off for the first time. It is true that it will not operate on the commercial air routes but is an anti-submarine weapon meeting the requirements of our time. Nevertheless, it is interesting for our consideration, inasmuch as even for this task it is fitted with twin propeller-turbines (Allison T-40) and is capable of a non-stop range of 4,600 miles with a 20,000 lb. "payload."

The facts have thus decided the discussion in favour of the engineers : the "Comet" and "Jetliner" jet transports are in point of fact now flying. Quite obviously, His Majesty the Public wants to travel in "modern" jet aeroplanes as soon as they have been established as equally safe and comfortable—but twice as rapid—as their airscrew-driven competitors. This is the case even if fares were to be higher under certain conditions, a contingency by no means proven. Because the customer is always right and because those who serve him are at an advantage when they are the first to divine and fulfil his wishes, it is very probable that the orders placed by BOAC and CPAL will very soon be followed by those of a number of other companies. However, the "Comet" will soon be joined by other types. This is in particular

true for the medium long-range routes of intercontinental air transportation. In a not too distant future, these will probably provide an exclusive domain for landplanes and flying-boats powered with turbojet engines.

On the other hand, the simultaneous appearance of the Vickers "Viscount" and Avro "Jetliner" types has given rise to new discussions, this time amongst the engineers themselves. Does the pure flying time over short ranges play such a decisive rôle that it pays to operate jet types, or should airscrew-turbine aircraft be chosen, which can be much better adapted to the conditions of congested commercial airports ? After the initial flight of a "Viscount" powered with two Rolls-Royce "Tay" radial turbines (on March 15th, 1950), *G. Edwards,* Chief Engineer of Vickers-Armstrong, stated that the type was a purely experimental aeroplane and that production was not intended. Moreover, he added, in the case of distances of less than 1250 miles propeller-turbines are considerably more economical. The four turboprops ("Dart 3") of the "Viscount 700" do 1.38 miles/Imp. gallon at 20,000 ft. and need 250 Imp. gallons/h. during stand-off at 5,000 ft., whilst the comparable radial turbines (four "Derwent 5's") do only 0.46 miles/Imp. gallon (one third !) and consume 600 Imp. gallons an hour during stand-off at 5,000 ft. Hence, is it worth while to reduce the overall travelling time from the centre of London to the centre of Paris from (let us say) two hours to 1 $^3/_4$ hours ? This is the question which faces us to-day !

At any rate, those participating in the debate are agreed that the propeller-turbine is well adapted for installation in many of the commercial transport types existing to-day and fitted with piston engines. It will make it possible to *bridge the gap* between conventional aircraft types and the jet-propelled aeroplanes of to-morrow. The Handley-Page "Marathon 2" (initial flight July 23rd, 1949) and "Hermes 5" (initial flight August 23rd, 1949) have already shown that this is possible ; a Convair "Turboliner" (at present under construction) and several others will constitute further proof.

Detailed information is given elsewhere in this issue on the characteristics of propeller-turbines and turbojets and on existing and operational types of this new civil power plant category, so that we can deal here directly with the aircraft themselves.

The Handley Page "Hermes 5," a long-range transport for 40 passengers, resulted from the installation of four Bristol "Theseus" propeller-turbines in place of the piston engines of the "Hermes 4."

Consolidated Vultee are at present equipping a twin-engined "Convair-Liner" with Allison T-38 propeller-turbines, to be tested experimentally as a pressurized cargo transport. The new type has been designated "Turboliner."

A round-up

Altogether a dozen turbine-powered commercial transport aircraft are to-day either undergoing flight tests or in construction. They all show more or less conventional wing designs. Nevertheless, there is no shortage of more radical projects for the more distant future ! Before discussing plans for to-morrow and the day after, it may be useful to take a closer look at existing types. Our compilation chiefly serves this purpose. It is subdivided into three range groups :

I. Short and medium stages on continental routes (up to 1250 miles).
II. Long stages on intercontinental routes (up to 2,500 miles).
III. Very long stages on transoceanic routes (over 2,500 miles).

Only Groups I and II show aircraft both with propeller-turbines and straight jets. For the very long ranges (Group III), the enormous fuel consumption of the pure jet engine has hitherto prevented the creation of jet-propelled types. It is only through the development of novel airframe designs and further economy in the fuel consumption of turbojets that a change can be brought about in this field.

Our round-up indicates the projected *payload* for a particular range, allowance being made for (unfortunately fairly variable) reserves, and shows the maximum range in still air for any given case. In each indication the flying altitude is that at which the pressure cabin simulates a pressure equivalent to that at 8,000 ft. in the outside atmosphere. It will be seen that the jet-propelled types, as well as those giant aircraft with propeller-turbine propulsion now under construction, are designed for extreme operating heights.

Take-off data refer to distance required to clear a 50-ft. obstacle and for "dry" take-off performance. Water-methanol injection in the compressor or combustion chambers should be employed only on hot summer days or on aerodromes at high altitude, merely to ensure that the take-off performance of the extremely temperature-sensitive turbojets attains its normal value. Take-off rockets or afterburning in pure jets continue to be undesirable in commercial air transport [1]. The indicated take-off distances nevertheless disclose that the runways of to-day's large airports probably will be sufficient for some time to come.

In the *group of short- and medium-range aircraft* the smallest type is the interesting *"Marathon 2" feeder aeroplane.* Originally designed by F. G. Miles for four "Gipsy Queen 70" 345-h.p. engines and constructed by *Handley-Page (Reading),* the type last year was equipped with two Armstrong-Siddeley "Mamba 1" propeller-turbines and enlarged fuel tanks carrying 414 Imp. gals. It possesses—in view of its short range—no pressure cabin, flies at an altitude of approximately

[1] The D.H. "Comet" nevertheless provides for two D.H. "Sprite" ("cold") take-off rockets, each of 5,000 lbs. thrust during 9 seconds working through the disassociation of highly concentrated hydrogen peroxide in aqueous steam (by means of a catalyst). These are provided for operation during unfavourable take-off conditions, their function being initiated by release of the compressed air for the peroxide. Whether or not they are to be retained in commercial transportation has not yet been decided.

Model of the projected Saunders-Roe "Duchess" transport flying-boat : six de Havilland "Ghost" radial turbines, 100,000 lb. gross weight, 74 passengers.

The first of the three Saunders-Roe SR/45 "Princess" giant flying-boats is to begin flight tests next year ; power plant : four Bristol "Coupled Proteus" airscrew-turbines plus two Bristol "Proteus."

10,000 ft. and is about 50 m.p.h. speedier than the original type. At the same time, it transports 800 lbs. more payload over the same ranges and can, as a result of its 180-yard shorter take-off run, make use of smaller aerodromes.

Consolidated Vultee is working on the conversion into the so-called "Turbo-Liner" of a twin-engined "Convair-Liner" by mounting two Allison T-38 airscew turbines (in place of the P. & W. R-2800 double radial engines), without other major alterations. The "Turbo-Liner" is to fly in the autumn of this year and will initially be tested experimentally as a cargo aeroplane over medium ranges. It will probably be 30-50 m.p.h. speedier than the "Convair-Liner," will likewise have a pressure cabin and is characterized by a large, rectangular and airtight cargo door.

Not all piston-engine aircraft are adaptable for the installation of propeller-turbines. For instance, nose-wheel landing gear is advisable in order to make use of the advantages of the reversible-pitch braking airscrew ; questions of strength, pressurization and installation must also be faced. For this reason, *Vickers-Armstrongs* found it practical to follow up their well-known "Viking" transport with the new *"Viscount"* (four Rolls-Royce "Dart 3's") [2].

Similarly, the prototype *Armstrong Whitworth A.W. 55 "Apollo"* was designed *ab initio* for airscrew turbines (four A.S. "Mamba 2's.") On April 10th, 1949, the aeroplane took off for its initial flight and has since been subjected to test flights totalling more than 100 hours. A second prototype is about to be completed. Whether or not the projected manufacture—there was talk of 25 aircraft—will be realized, remains to be decided.

Whereas all these types differ externally from conventional aircraft only by their somewhat longer and slimmer power plant nacelles, the *Avro "Jetliner,"* the last short- and medium-range type, represents the revolutionary tendency. This is manifest—apart from the turbojets—from the short undercarriage and the high-set elevator unit. Regarding cruising speed, the type has an advantage of 125-140 m.p.h. over airscrew-driven types. Despite this, a straight wing sufficed for the indicated cruising speed of 450 m.p.h. at 30,000 ft., i.e. for operational Mach numbers in the neighbourhood of 0.7. In order to facilitate maintenance and interchangeability, the engines, are fitted close to the underside of the wing—somewhat in the form of "pods without stalks." Particular emphasis was placed on high cabin pressure to make possible rapid descent from cruising altitude. [3]

The medium-range group at present includes only two types : the "Hermes 5" and the "Comet." But it is in this particular field that a number of large commercial landplanes "converted" to propeller turbines probably will join the others in the near future. In addition, Saunders-Roe have completed plans for a jet-propelled commercial flying-boat, the "Duchess."

The *Handley-Page "Hermes 5"* long-range aeroplane powered with four Bristol "Theseus" airscrew-turbines was derived from the "Hermes 4" (equipped with four Bristol "Hercules 763" piston-engines) developed for BOAC and now in operation. Provided with new Handley-Page high-performance slotted flaps, it transports—at an increased take-off weight—a payload increased by 3,300—3,850 lbs. over identical ranges and flies (at an altitude of 15,000 ft.) 90 m.p.h. faster than its predecessor.

In the case of the *De Havilland "Comet,"* the advantage in speed resulting from the pure jets (four D.H. "Ghost") is very obvious. At the same time, its maximum range in still air is even greater than that of the "Hermes 5." This was obtained by extreme limitation

[2] Described in detail by James H. Stevens (Vickers Armstrongs "Viscount 700") in "INTERAVIA Review of World Aviation," No. 4, 1950, p. 199—204.

[3] Cf. James C. Floyd : Avro C-102 "Jetliner," in "INTERAVIA Review of World Aviation," No. 5, 1950, p. 261—266.

The British Aeroplane Co. is at present building the prototypes of two new turbine-powered long-range commercial transports : left, Bristol "Britannia" (four Bristol "Proteus") ; right, Bristol "Brabazon 1, Mark 2" (four Bristol "Coupled Proteus").

The Vickers "Tay-Viscount," a "Viscount" converted to jet-propulsion (left, two R.-R. "Tays"), and the Avro "Tudor 8" (and the "Ashton") serve merely for flight testing at high altitude; transport operation is not envisaged.

of the airframe weight [4] with the aid of novel methods : Redux plastic bonding at all points not subjected to heavy stresses, notably reinforcements, use of over-dimensioned skin sheets in order to save rivets, integral fuel tanks, elimination of equipment components owing to simpler power plant operation, bleeding-off of de-icing hot air and cabin air from the radial compressors of the power plant, etc. In addition, everything was done to decrease cruising consumption by increasing operating altitude and cruising speed. In order to improve the critical Mach number (to about 0.8), the trapezoidal wing of only 11.5 % thickness was designed with a sweepback of 20°, relative to a wing chord of 25 %. The tail unit was kept straight. Amongst the remaining peculiarities of the "Comet" mention may be made here of the relatively low wing loading at take-off (52 lb./sq. ft.), the dual hydraulic control boost and the flush installation of all communication and navigation aerials. More than 250 flying hours of the first prototype within 9 months have already proved that maintenance is considerably less costly, owing to simplified construction and equipment as well as to the type's notable freedom from vibration, than is the case with any other commercial transport. *Moreover, the direct operating cost of the "Comet" (per ton-mile) is at least 20 % less than that of to-day's long-range commercial transport aircraft.*

The *projected Saunders-Roe "Duchess"* commercial flying-boat, powered with six D.H. "Ghost" jets, shows what further progress in intercontinental transportation during the next few years is conceivable : with increasing size, the flying-boat attains an ever better payload/gross weight ratio, since higher wing loadings, not limited by considerations of take-off distance, can be chosen. With the SR/A1 jet-propelled fighter flying-boat, Saunders-Roe gained valuable experience and therefore willingly accepted a suggestion put forward by Sir Miles Thomas, Chairman of BOAC, to investigate the possibilities of a jet-propelled commercial flying-boat. By means of model tests, the basic form of the boat has already been determined. The wing is characterized by a sweep-back of about 30° and pronounced downward dihedral ; the tail unit likewise possesses a pronounced sweep-back. The wing floats are to be folded to the end of the wing tips in flight.

All *large aircraft for very long ranges* are to-day still in construction. The smallest of these, the *Bristol 175 "Britannia"* (four Bristol "Proteus" airscrew-turbines) is, it is true, designed for BOAC's medium-range Empire routes, but nevertheless is to attain a maximum range of 5,000 miles. Two prototypes are nearing completion, a series of 25 are on order for BOAC—The propeller-turbine version of the giant Bristol 167, the *"Brabazon 1, Mark 2,"* to be powered with four "Coupled Proteus" twin engines, will only begin its flight tests in 1952 and will probably—should it prove operationally suitable —be utilized in transoceanic traffic.—The three *Saunders-Roe SR 45 "Princess"* long-range flying-boats now under construction on the Isle of Wight are to be completed earlier than was formerly planned ; the first is to fly next year [5]. These boats are designed for transoceanic operation.

Conversion projects

As previously stated, airscrew-turbines are well adapted for the conversion of many piston-engined commercial transport types insofar as these are adequately stressed for higher speeds and are capable of carrying sufficient fuel for increased consumption. This is applicable to aircraft of every range category.

As is well known, even the Douglas DC-3, although it possesses no nose-wheel landing gear, was experimentally fitted with A.S. "Mamba" and R.-R. "Dart" propeller-turbines [6]. In addition, Douglas and Lockheed are planning to flight test their DC-6 and "Constellation" four-engined commercial transports with Allison T-38 engines in the near future, which they expect to yield an increase in cruising speed from the present 280 m.p.h. to about 300 m.p.h. and hence a 30 % decrease in direct operating costs per passenger-mile. The range will probably remain approximately unchanged. In this connection it should be mentioned that the new Lockheed L-1049 "Super Constellation" and Glenn L. Martin 4-0-4, at present designed for piston power plant, have been dimensioned and equipped *a priori* for subsequent conversion to airscrew-turbines (Allison T-38).

In all probability, Boeing Airplane Co. are also playing with the idea of fitting their "Stratofreighter" and "Stratocruiser" four-engined transports with Allison T-40 twin airscrew-turbines (in place of the "Wasp Major" four-row radials) to increase take-off power by 50 %. Other giant long-range aircraft hitherto operated exclusively

Project for a long-range transport of the Boeing Aircraft Co. with a 35° swept wing ; four (or six) axial-flow jets uniformly spaced along the wing span in suspended pods.

[4] The actual airframe weight has not yet been released.

[5] Reports on the SR/45 "Princess" have frequently appeared ; cf. *"A Giant Flying-Boat of 140 Tons"* in "INTERAVIA Review of World Aviation," No. 2, February 1948, p. 105, and No. 10, October 1949, p. 621.

[6] Cf. "DC-3, Super DC-3, Mamba DC-3 . . ." in "INTERAVIA Review of World Aviation, No. 11, November 1949, p. 673—676.

A project of Lockheed Aircraft Corp. of 1948 for 40/50 passengers. Four jets, swept wing and tail unit.

for military purposes (with "Wasp Major") seem to be waiting for turboprops in order to gain a foothold in commercial air transportation. The Lockheed "Constitution," Douglas "Globemaster" (C-74 and C-124) and Convair XC-99 could then transport up to 170 passengers over long ranges.

On the other hand, the consensus of opinion is that the conversion of to-day's operational transport types to pure jet propulsion is either unfeasible or uneconomical. The sudden step to that range of speed at which jet engines operate economically (over 470 m.p.h.) cannot be achieved with conventional wing and fuselage designs. Apart from this, these aircraft are not stressed to support an increase in the aerodynamic forces to about double their former value.

The Vickers "Nene-Viking" (initial flight, April 6th, 1948), Avro "Tudor 8" (initial flight September 6th, 1948) and more recently the Avro "Ashton" (reconstructed "Tudor 2"; six aircraft in construction) are purely experimental and designed simply to obtain operational experience (noise generation, altitude testing of equipment etc.). With 385 m.p.h. as the cruising speed at an altitude of 30,000 ft. (350 m.p.h. at 25,000 ft.), the "Ashton" still remains far below the economical limit of jet propulsion, which of course in itself by no means prevents its use as a laboratory type. The same applies—though at somewhat higher speed—to the Vickers "Tay-Viscount" experimental aeroplane.

Nevertheless, it is interesting to note recent reports stating that the Douglas DC-6 and Boeing "Stratocruiser"—apparently emulating the Convair B-36D—are to be equipped with two auxiliary radial turbines in out-rigged pods in order to increase their cruising speed to 360 m.p.h. —400 m.p.h. as well as shorten their take-off distances.

Bréguet 97 "Fulgur," a French project in two versions : left with four twin turboprops and contra-rotating airscrews ; right with four radial turbines.

Plans for to-morrow

In the domain of turbine-powered commercial transport aircraft, Great Britain has achieved a significant advance through the creation of the "Comet" and "Viscount" and notably through her pioneering performance in power plant development. No wonder then, that the United States—as well as France and other nations—are striving to catch up with Britain as soon as possible. The Americans are perfectly aware that they can hold or regain their lead in the construction of transport aircraft only by going one step farther than de Havillands with their "Comet," namely by designing all their new types consistently for cruising speeds of more than 560 m.p.h. This would require a transition to very thin, strongly swept-back wings.

On this principle Boeing has worked out the project for a large aircraft for 60 passengers to be powered with four (possibly six) turbojets (Allison J-35 ?). Based on the B-47 "Stratojet" bomber, the aircraft is to have approximately the same dimensions as the "Stratocruiser" and feature a high-wing with a sweep-back of 35°. The engines are to be suspended in pods spaced at regular intervals along the entire wing span in order to spread the load uniformly over the wing. For operation on American continental routes, the wing fuel tanks will suffice ; for trans-atlantic operation, streamlined auxiliary tanks would be mounted under the wing. Cruising speed is to be 560 m.p.h. at 40,000 ft.—The period of development is estimated at 3 ½ years —after receipt of an order ; at the present moment work is being carried on with wind tunnel models only.

In an earlier project of Lockheed, a swept-back low-wing monoplane for 40 to 50 passengers, the four jets are arranged in pairs in the wing leading edge close to the fuselage ; cruising speed was estimated as 340 m.p.h. at 38,000 ft.—range approxiamtely at 4000 miles. The fuel taks were to be housed in the centre of the fuselage, an arrangement which the airline companies would hardly have appreciated.—The *Republic Aviation Corp.* has discussed, through the medium of their Vice-President and Chief Engineer, *A. Kartveli,* the possibility of converting their "Rainbow" high-speed commercial transport into a 35° swept-back wing type powered with four jets, capable of a range of 2000 miles at 560 m.p.h. cruising speed at an altitude of 40,000 ft.

In France, *Louis Bréguet* derived two new models from the well-known Bréguet 761 cargo transport. Both are called Bréguet 87 "Fulgur" and fitted with a straight wing and planned for 100 passengers and freight. The *Bréguet* 973 propeller-turbine version would be powered with four "Double Mamba" or two Allison T-40 twin engines ; the jet-propelled *Bréguet* 972 would be fitted with four jets of an as yet unstated type mounted close to the fuselage. The *SNCA du Sud-Ouest* is advertising an *SO 5100 "Champagne"* commercial transport aeroplane featuring a moderately swept-back wing and to be powered with four turbojets.

One fact is certain to-day : the future belongs to the gas turbine ! True, piston-engined aircraft will not die out—they will continue to operate at slower speeds and lower altitudes : as sports and touring aircraft, as feeder transports and low-flying, economic freighter aeroplanes. The field of medium altitudes, medium speeds and either short or very long ranges will in the immediate future be dominated by the propeller-turbine. But the jet-propelled commercial transport aircraft will advance from the medium-long-distance stages of the intercontinental routes already assigned to it to ever greater ranges, flying altitudes and cruising speeds.

Long-range Commercial Transport Aircraft with High Subsonic Speeds

by Professor H. HERTEL

As stated elsewhere in this issue, the operation of intercontinental commercial transport aircraft with jet power plant can be looked upon as certain within the near future. With this the " next step " in transportation is ensured, and it is therefore justifiable to ask what will be the appearance of the step after that. Will to-day's commercial jet aeroplanes be operated on the Atlantic routes, with refuelling during flight ? Will high-speed swept-back bombing aircraft be fitted out with transport fuselages ? Is there any future for the Northrop YB-49 or the enlarged version of the Armstrong Whitworth AW. 52 flying wing jet-propelled types, of which recently little has been spoken, in commercial flight ? Or is the time ripe for a search for fundamentally new solutions ?

Professor Heinrich Hertel's exposé shows us a new path to be taken in this direction. The author, well known since 1926 as a scientific collaborator of the German Experimental Station for Aeronautics (DVL), was Technical Director of the Heinkel Works in Rostock from 1933 to 1939, and Technical Director in Charge of Developments of the Junkers Works in Dessau from 1939 to 1945. Under his supervision numerous aircraft designs, such as the Heinkel He 100 world-record aeroplane, the Heinkel He 174, Germany's first jet machine (1939), and the Junkers Ju 287 jet-propelled bomber, have been developed. At the same time, Prof. Hertel held lectures at the Universities of Rostock and Braunschweig. From 1946 to 1949 he directed a Research Department of the S.N.C.A. du Sud-Est French national aircraft works, notably for the design of high-speed long-range commercial transport aircraft. The Editors.

The creation of modern power plant has made it possible for the aircraft designer to construct aeroplanes capable of reaching high subsonic or even supersonic velocities. Although progressive plans for the future are already dealing with supersonic commercial aircraft, whose possibility seems proven owing to the further development of turbojet engines and in connection with the ram-jet, a great deal of time is still going to be necessary for their realization. For this reason, the commercial aeroplane with high subsonic speed is of outstanding importance for the near future, especially as this type of high-speed aircraft, given the proper aerodynamical form, is capable of good economy over very long routes.

In order to achieve " *economic transportation over the maximum flight range at maximum cruising speed* ", the following consideration is essential : Turbojets not only make high speeds possible, but the higher the speed, the more economically they function. This will be the case where the aeroplane makes use of the design possibilities appropriate to turbojets.

This report is an attempt to contribute towards the solution of the problems concerning the design of such commercial transport aircraft, and hence in general of aeroplanes satisfying the requirements of modern power plant. In line with the Editors' wishes, the report has been written within the confines of popular understanding, and intentionally avoids a too detailed survey of the comprehensive and specialized investigations (aerodynamics, weights, construction) leading to the solutions suggested and backing up the following considerations.

For future world air traffic the flight range to be aimed at can be regarded as the " transoceanic " distance of 6,000 km—as compared with the " intercontinental " range of 4,000 km. By means of intercontinental aircraft (powered with piston engines, airscrew turbines or turbojets), the most important centers of the world can be interconnected. However, it must not be overlooked that there exists a series of overseas connections to be reached only by detours, which could otherwise be avoided by transoceanic aeroplanes. The importance of these transoceanic routes is apparent from Fig. 1.

The reduction in flight time by means of transoceanic aircraft, as manifested in the examples chosen, results from the fact that (1) detours over intermediate landing fields are no longer necessary, (2) there is no loss of time owing to intermediate landings (approach, landing, take-off delay, take-off) and owing to climb to cruising altitude after intermediate landings, (3) as well as the fact that greater cruising speed owing to smaller utilizable space requirements is possible in the case of the transoceanic aircraft.

The following investigations were undertaken chiefly with the aim of finding ways and means towards the realization of the transoceanic high-speed aeroplane.

Characteristics and Installation of Power Plant

Powering with turbojets is especially appropriate in the case of long-range aircraft designed to fly at high subsonic speeds and thus with an economic fuel consumption per mile. Propeller turbines on the contrary are favourable only in the case of moderate cruising speeds. The propeller turbine attains its optimum at about 700 km./h., whilst that of pure piston engines and compound piston engines is reached at even lower speeds.

EXAMPLES OF FLYING TIME

For the indicated cruising speeds and a 120 km/h headwind (limiting case).

Paris-New York route	
" Transoceanic " aeroplane (925 km/h ; non-stop)	7 h. 30
" Intercontinental " aeroplane (830 km/h ; one intermediate landing)	10 h.
Present flying time	20 h.
Dakar-New York route	
" Transoceanic " aeroplane (925 km/h ; non-stop)	8 h.
" Intercontinental " aeroplane (830 km/h ; one intermediate landing)	12 h.
Present flying time (via St. Marie)	24 h.
Present flying time (via Lisbon)	29 h.

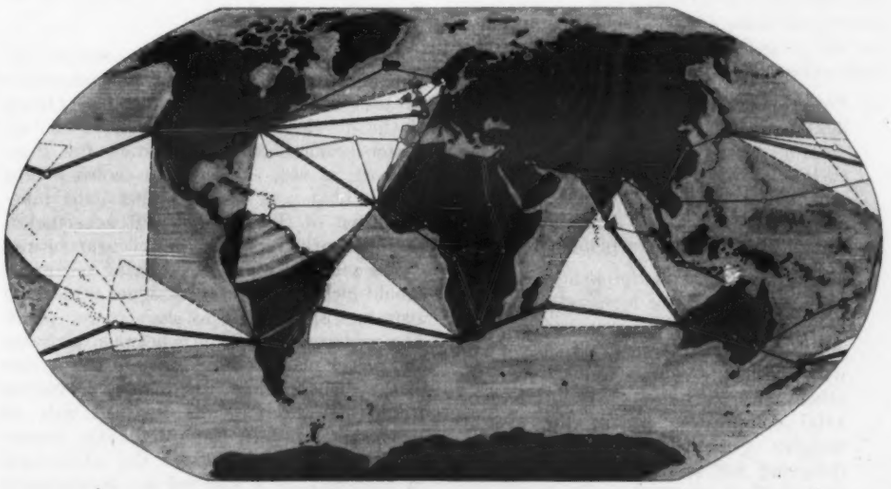


Fig. 1 : World flight route map with " transoceanic " routes (thick lines) and the corresponding sectors for a range of 6,000 km. (clear areas)—as compared with intercontinental detour routes (thin lines).

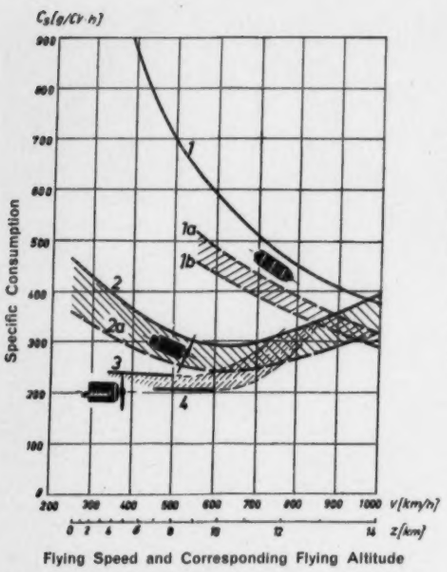


Fig. 2: Specific fuel consumption (including oil) relative to effective power (shaft h.p. x airscrew efficiency coefficient, or thrust expressed in h.p.) versus flying speed and corresponding altitude.

1 Turbojet (further developments 1a and 1b)
2 Propeller-turbine (further development 2a)
3 Piston engine
4 Compound engine

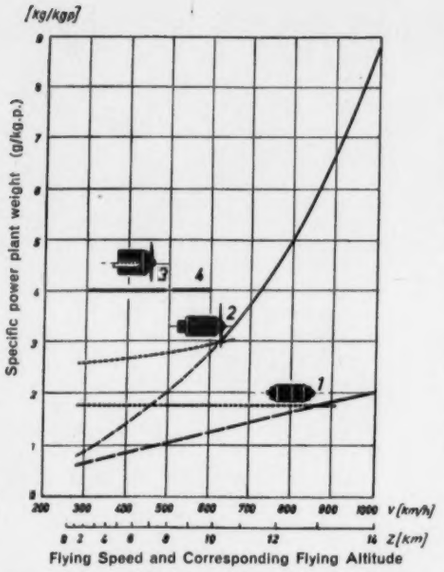


Fig. 3: Power plant weights per kg. cruising thrust versus flying speed and corresponding altitude (present power plant). Where the lines are broken higher outputs—and hence weights—are necessary for take-off and indicated by dotted lines.

1 Turbojet
2 Propeller-turbine
3 Piston engine
4 Compound engine

Fig. 2 indicates the *specific fuel consumption* versus flight speed at the maximum favourable altitude, i.e. for optimum dynamic pressure [1] for to-day's power plant and the further stages of development to be expected (*a* and *b*). From this it is apparent that in the case of a cruising speed of 600 km./h. the propeller turbine operates at about one-half the specific fuel consumption of the turbojet, though at about 1000 km./h. the specific consumption of both power plants is equal. The reason for this lies in the fact that the propeller turbine shows a decreasing airscrew efficiency, whilst the jet efficiency augments.

Hence, in the case of high subsonic speeds the turbojet is greatly superior—at approximately the same specific fuel consumption—to the propeller turbine, both economically and technically:

a) Power plant installation is considerably lighter in the case of the turbojet (cf. Fig. 3). At 700 km./h. the propeller turbine is twice and at 900 km./h. about four times as heavy as the turbojet. Therefore, with equal airframe size the useful load of the jet-plane is greater.

b) The arrangement of the airscrews on an airframe designed for high speeds (swept-back wing) involves considerable difficulty and in any case can be solved with pusher airscrews only. On the other hand, turbojets, particularly with axial compressor, permit the aircraft designer a great degree of freedom in designing for minimum drag and high critical Mach number.

[1] Optimum dynamic pressure depends of course on aircraft design. The correlation is based on comparative projects.

c) Airscrews necessitate the distribution of the engines separated by large intervals over the wing span. As opposed to this, the central arrangement of the turbojets results in better flight characteristics in the case of failure of an outboard engine.

d) The aesthetic superiority of the jet-plane, designed with a greater degree of freedom and without airscrews, can not be doubted.

e) Turbojets, as compared with airscrew engines, are a great deal simpler, easier to inspect, easier to operate and to maintain, and for these reasons also safer.

f) Annoying disturbances set up by vibration and noise are at a minimum in the case of turbojets.

At the present time, the considerably higher thrust at take-off is an undeniable advantage of the propeller turbine. Owing to the development of compressive cooling (water-methanol injection before the compressor), as well as of the air-cooled hollow turbine blade and of afterburners, the take-off thrust of the turbojet will nevertheless be sufficiently increased in the near future.

The progress made in powering technique should incite the aircraft designer to develop airframes appropriate to such power plant. The requirement of unity between airframe and power plant is more insistent in the case of the turbojet than ever before. Deviation from this criterion was justified only so long as jet-aircraft were built for experimental purposes, or where the advantages of turbojets in a speeded-up development project — and without risks in airframe construction—had to be exploited at least to a certain degree as soon as possible.

The space requirements of turbojets, especially in the case of small-diameter axial machines, are so modest that "invisible installation" is possible. Fig. 4 shows such an arrangement as compared with two external installations on pods, and Fig. 5 demonstrates that the thrust losses in the case of invisible installation are considerably less than those of the external engines. The difference becomes even more apparent when the additional fuel consumption is taken into consideration (Fig. 6).

Airframe Designs

One method of obtaining invisible installation is the flying wing. The conception of the flying wing has undergone outstanding promotion with the creation of the XB 35 and XB 49 by *J. B. Northrop*, a pioneer performance of modern aeronautical technique. Inasmuch as the basic type of the XB 35 was developed for airscrew engines, its shape is adapted to moderately high cruising speeds only. In designing its form it is obvious that at first only the more modest space requirements of the bombing aeroplane were taken into account; despite this, it is possible—with few alterations—to derive a passenger-and-mail aircraft from it. In the conversion to jet propulsion (type XB 49) the power plant has become practically invisible.

In the following, comparison is made between various designs of long-range commercial transport aircraft fitted with turbojets. In Fig. 7 these are all without exception sketched, exclusively for purposes of design comparison, with the same power plant (four ATAR 101 B). In an inspection of the various types, it is suggested that one begins with *Type VI* (below to the right), a flying wing compromise type of aircraft with an overall weight of 50 to 60 tonnes and a wing area of 200 sq. m. The other flying wing designs (Types V and IV) are drawn with the same wing area (and identical power plant) in order to facilitate a comparison of form[2].

[2] However, their realization with sufficient utilizeable space calls for considerably larger aircraft, and therefore correspondingly larger or more numerous power plant (cf. Fig. 17).

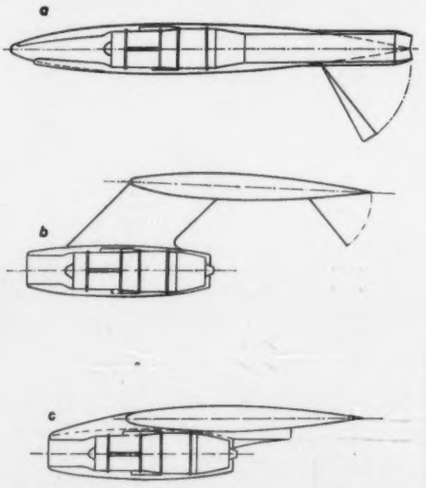


Fig. 4: "Invisible" installation (a) and external installation (b and c) of turbojets with axial compressor. The external installation on consoles (b) or directly on the wing (c) can be utilized for single (I) or dual turbojets (II) (cf. Figs. 5 and 6).

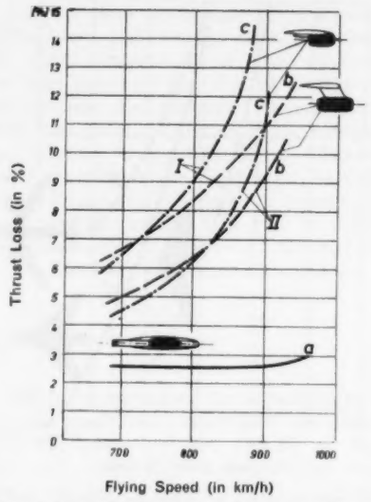


Fig. : 5 Comparison of thrust losses resulting from internal losses and external drag as caused by various installation methods.

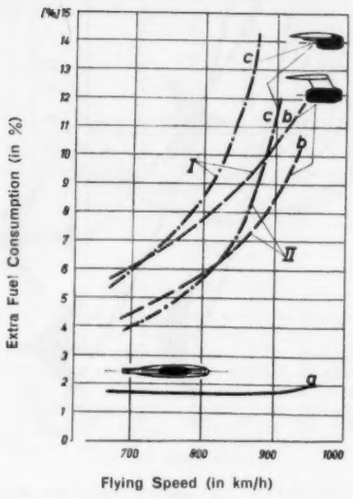


Fig. 6 : Comparison of extra fuel consumptions resulting from internal losses and external drag as caused by various installation methods.

In order that they may be directly compared with the flying wing Type VI, the " classical " aircraft I, II and III, characterized by their fuselages and tail assemblies, have on the one hand 50% higher wing loading, hence 33% smaller wing areas, and on the other hand fuselages with equal utilizeable space and floor area (as VI). They likewise possess four engines.

In general high-speed long-range commercial transport aircraft powered with turbojets involve considerably more difficult space problems than is the case with bombing aeroplanes. In addition, the Mach problem and the reduction in resistance is decisive. The *" pure flying wing " for maximum speed (Form V)* is for this reason particularly well adapted to its task. The form suggested by me is characterized by considerable sweep-back, small aspect ratio, small percentual profile thickness and by a centre section of greater chord and forward emplacement. The requirement of placing the largest possible cabin with standing height in the centre section of the flying wing, despite decreased percentual profile thickness, makes the smallest possible aspect ratio necessary. This, however, become supportable owing to the high flight speed (with regard to Induced Drag) and the relatively low wing loading of the flying wing. In the case of this " compressed " form, an essential gain in airframe weight, apart from the aerodynamic advantages (drag and critical Mach number) can be attained.

The *Form VI of a " Flying Wing Compromise Aircraft " for maximum speed* was suggested because the pure flying wing Form V (and to an even greater extent Form IV) permits sufficient cabin space in the case of very large aircraft only, so that for smaller aeroplanes a central fuselage body is necessary. The loss in performance (as compared with V) can be contained within sufficiently small boundaries by proper aircraft design, so that the advantages of the pure flying wing are essentially retained.

For the sake of comparison, a " pure flying wing " for medium speed *(Form IV)* of large aspect ratio, trapezoidal periphery with a centre section enlarged towards the rear, small degree of sweep-back, large profile thickness (approximately corresponding to that of the Northrop XB 49), as well as the " classical " *Project II* of the most modern conception (Boeing XB 47 high-speed aeroplane) have been chosen. Form III (corresponding to an ideal project taken from the literature) is probably not very advantageous, and has only been included for the sake of complete pictorial comparison. *Form I*, the " classical " form for moderate speeds, has also been included for the sake of completeness.

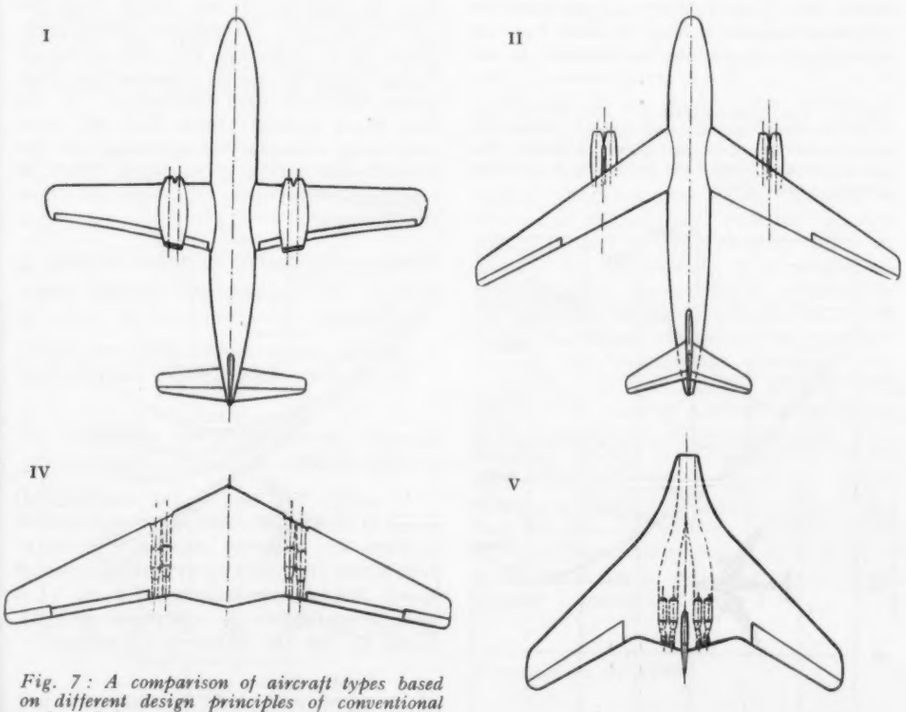


Fig. 7 : A comparison of aircraft types based on different design principles of conventional and of flying wing conception.

I Classical form for medium speeds
II Classical high-speed form
III Classical high-speed form with reduced wing span
IV Flying wing of large wing span for medium speeds
V Flying wing of small wing span for high speeds
VI Flying wing compromise form for high speeds and gross weights of 50 to 60 tonnes

The Influence of Fuel Consumption

Fuel consumption plays a decisive rôle in the case of the long-range jet aircraft. Each and every reduction in consumption permits a considerable increase in the payload, inasmuch as fuel takes up about one-half of the take-off weight in the case of a transoceanic aeroplane with a theoretical range of more than 8000 km. In a jet-powered aircraft, consumption (in kg./km.) decreases with increasing altitude, provided that the cruising speed can also be increased correspondingly.

Fig. 8 shows the consumption of a flying wing such as in Type VI in correlation to cruising speed—with flight altitude as parameter, and corresponding to thrust requirements at medium gross weight. In order to make the presentation more independent of the size and number of the turbojets, the ordinate has been indicated in percentages of consumption, whereby the aircraft's consumption at 950 km./h. at an altitude of 14,500 m. (the values sought in the flying wing development) has been assigned 100%. The envelope indicates the minimum consumption possible of attainment at a particular cruising speed at its correspondingly optimum cruising altitude. With increasing speed the optimum flying altitude likewise increases.

From this it can be seen that there is a very essential decrease in consumption with an increase in cruising speed and altitude. The broken curve passes through the minima of consumption for definite flying altitudes. This curve becomes decisive when the flight altitude is limited for certain reasons (available thrust, limitations on pressure cabins, tactical reasons). The minimum consumption at a particular altitude is attained at a definite speed. The consumption decreases with an increase in altitude ; but the flying speed must be increased correspondingly. From this it is apparent how important design with respect to high speed is in the construction of modern long-range aircraft powered with turbojets. Pronounced losses in cruising speed owing to mistakes in design (too low critical Mach number) can have a very considerable effect on the economy of the aircraft.

The relationships in the case of a classical design with turbojets are in principle the same. For Type II they are presented in the same manner in Fig. 9. Here too, the percentual consumptions are referred to the consumption of Type VI at 950 km./h. and 14,500 m.

From Fig. 10, in which the consumption curves in still air are set up comparatively for the high-speed flying wing (VI), the medium-speed flying wing (IV) and the conventional high-speed aeroplane (II), it can be seen that curves VI and IV run approximately parallel to each other. Hence, the two flying wing types show equal consumption, despite the fact that the compressed form flies about 150 km. faster than the attenuated type. Nevertheless, when compared with Form IV, the redesigning of Form VI for high speeds guarantees an even *greater* difference than 150 km.p.h. (cf. critical Mach number curve, Fig. 14), thus permitting even further reduction of the consumption over a given range. Thus, as compared with Form IV, Form VI offers the following :

a) shorter flying time for a specific range,

b) lesser fuel consumption, therefore better payload,

c) smaller airframe weight of the compressed form, hence even greater improvement in payload,

d) more favourable space utilization (cf. Figs. 17-20).

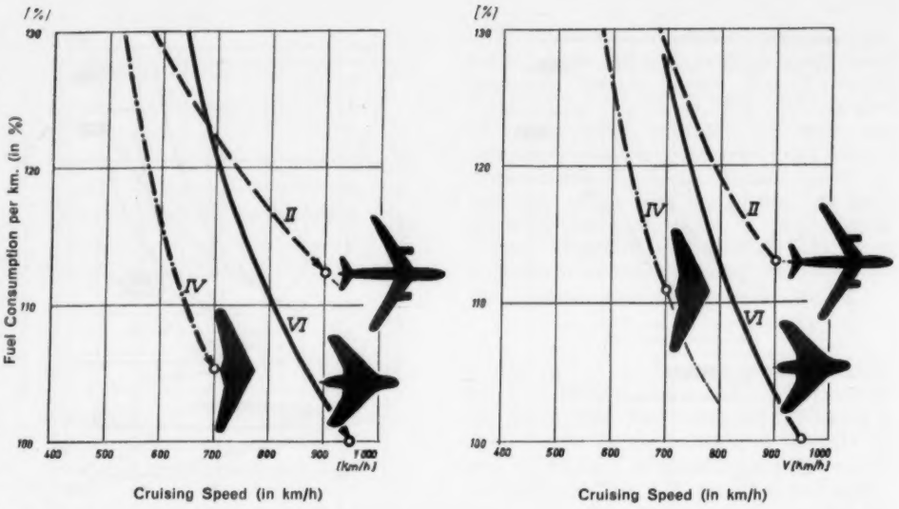
At about 700 km.p.h. the conventional Form II shows about the same consumption as Form VI. However, when as is necessary both forms are tuned up to a higher cruising speed, the fuel consumption of Form VI is more favourable. As compared with II, Form VI has the following advantages :

a) a slightly higher speed,

b) smaller fuel consumption,

c) a markedly smaller airframe weight,

d) smaller power plant (see below).

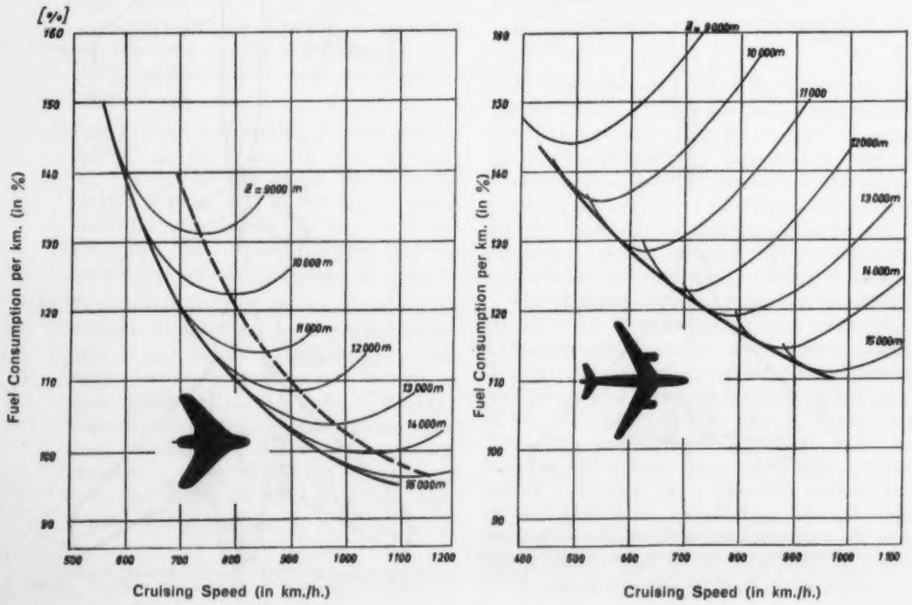


Figs. 10 and 11 : A comparison of the minimum fuel consumptions at optimum altitude per km. flying route in still air (left) and against a 120 km./h. headwind (right). The diagrams are based on the following assumptions :

Aircraft type	Form VI	Form IV	Form II
Average wing loading	200 kg/m²	210 kg/m²	300 kg/m²
Drag coefficient	0.0085	0.010	0.018
Aspect ratio	4.5	8.0	9.6

Fig. 8 : Fuel consumption per km. flying route of the compressed flying wing (Form VI) versus cruising speed and flying altitude. Consumption at 950 km./h. at 14,500 m. altitude equals 100 %.

Fig. 9 : Fuel consumption per km. flying route of the classical sweptback aeroplane (Form II) versus cruising speed and flying altitude. The consumption of Form VI at 950 km./h. at 14,500 m. altitude equals 100 %.



The last three advantages allow a greater payload or a greater range at smaller operating costs. Inasmuch as the maximum fuel load taken on board must always take into account the maximum possible headwind, the decisive criterion is the consumption relative to the number of kilometers over ground at a maximum headwind (e.g. 120 km.p.h.). Such a consumption is graphically presented in Fig. 11. Here, the advantages of Form VI become even more apparent.

Power Plant Performance

Any investigation of the necessary power required for Form VI must take into account both the speed and the altitude of flight (Fig. 12). As may be recognized, every speed can be correlated with a minimum engine power, as represented in the curve. The corresponding optimum flight altitude increases with increasing speed. Should, on the contrary, a particular engine power be available, then the maximum cruising altitude (decisive for consumption) is attained at a definite optimum flying speed. The greater the engine power and thus the flying altitude, the greater this optimum flying speed. With any decrease in cruising speed as compared with the optimum—using equally strong turbojets—the attainable flying altitude would decrease and thus fuel consumption would increase.

One advantage of Form VI as compared to Form II lies in the fact that at equal flying speed, the most economic flying altitude of the flying wing VI—owing to the small value of the drag coefficient and the smaller aspect ratio—lies considerably lower, so that the required engine power (and hence both weight and space requirements) is smaller in the case of the flying wing.

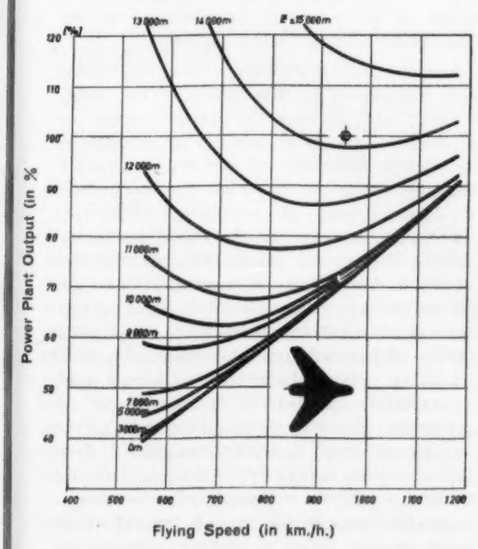


Fig. 12 : Required power plant output in the case of the compressed flying wing (Form VI) versus flying speed and altitude. The total maximum static thrust at sea-level required for a speed of 950 km./h. at 14,500 m. altitude equals 100 %.

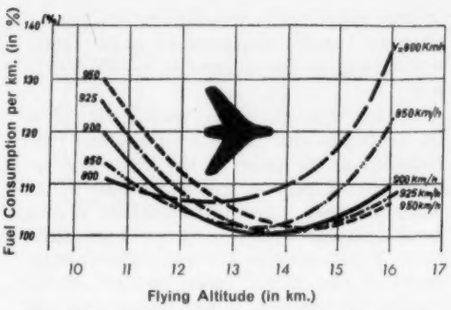


Fig. 13 : Fuel consumption per km. flying route of a compressed flying wing (Form VI) at various speeds and altitudes. The consumption at 900 km./h. at 13,500 m. altitude is assigned the value of 100 %; the curves are based on the following drag coefficients in the critical Mach-Number range : 0.0085 for 900 km./h.; 0.0088 for 925 km./h.; 0.00935 for 950 km./h.

In the vicinity of the optimum, the course of the curves is so flat that, for instance, at 14,000 m. altitude a deviation from the optimum (950 km.p.h.) to 850 km.p.h. or 1100 km.p.h. necessitates a power plant of only 2% greater output. From this it can be seen that the attainment of high flying speeds during high-altitude flight is practically independent of engine performance, and that an increase in the critical Mach number is therefore the decisive measure to be taken.

When designed for very high Mach numbers, the aircraft does still not manage to attain the target aimed at, but the disturbing domain of local supersonic speeds is very small and thus the increase in drag owing to Mach influence is gentle up to the cruising speed sought, the advantage of greater cruising speed compensates largely for the influence of the Mach augmentation on fuel consumption. In this case, it can be practicable to fly " into " this domain of increased drag. Fig. 13 shows an example of this kind : When in the case of an aircraft for 950 km.p.h. at 14,200 m. altitude, the critical Mach number (drag increase) is reached at 900 km. p.h., then the optimum flying altitude is approximately 1,000 m. lower. At this altitude, it is possible by exploiting the power surplus required for the projected higher flying altitude to fly within the domain of increased drag without causing any considerable additional consumption. At 950 km.p.h. with a 10% c_{zn} increase, there is a resulting additional fuel consumption of approximately 3%. Moreover, should it be possible to install somewhat more engine power or should reserves of power be allowed for in the design, then the extra fuel consumption at optimum flying height resulting from a speed increase of 900 to 950 km./h. in the domain of "Mach increase" amounts to only 1.5%.

Aerodynamic Questions

As already stated, in order to achieve high cruising speeds, the design for high critical Mach numbers is decisive. This is achieved by small percentual thickness and sweep-back. For a wing crabbing with an angle of ϕ, the critical Mach number is perfectly well known from calculation and experiment. Nevertheless, difficulties arise through the adjunction of a right and a left wing, whereby there is a bend in the plane of symmetry (2ϕ). As a result of this " middle effect ", the critical Mach number is considerably reduced. Fig. 14 [3] supplies us with information concerning the magnitude of the critical Mach number owing to profile thickness, angle of crabbing and middle effect. From this it is apparent that for Form V a critical Mach number of about 0.85 (approximately 900 km./h. at high-altitude flight), whereas for Form IV one of 0.66 (about 700 km./h. at high-altitude flight), can be expected, and hence that it is the development of Form V which is necessary for the future.

The pronounced reduction of the critical Mach number resulting from the middle effect disproves the conception that in the case of the " pure " flying wing each wing half must be a trapezium. The aim of Form V is rather to reduce the local supersonic speeds in the dangerous middle section (by means of three-dimensional airflow around the wing and small percentual thicknesses),

[3] The increase in drag owing to Mach effect, which can begin to operate very early but also very gently, must be very carefully studied when determining design. The estimation of a critical Mach value should give only an approximate picture of the influence of design in the high subsonic range. The critical Mach value of a swept wing can be determined in rough approximation from the equation $M_{crit.\,\phi} = M_{crit.\,(\phi\,=\,0)} / \sqrt{\cos \phi}$ (very favourable assumption).

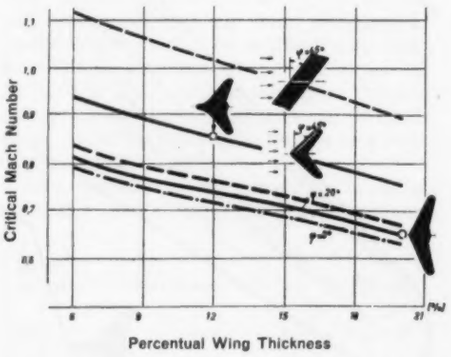


Fig. 14 : Critical Mach number of crabbing wings and swept-back wings versus percentual wing thickness (δ) and angle of sweep-back (ϕ).

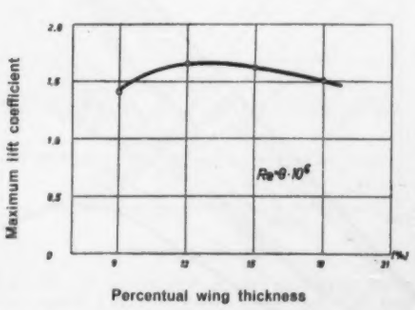
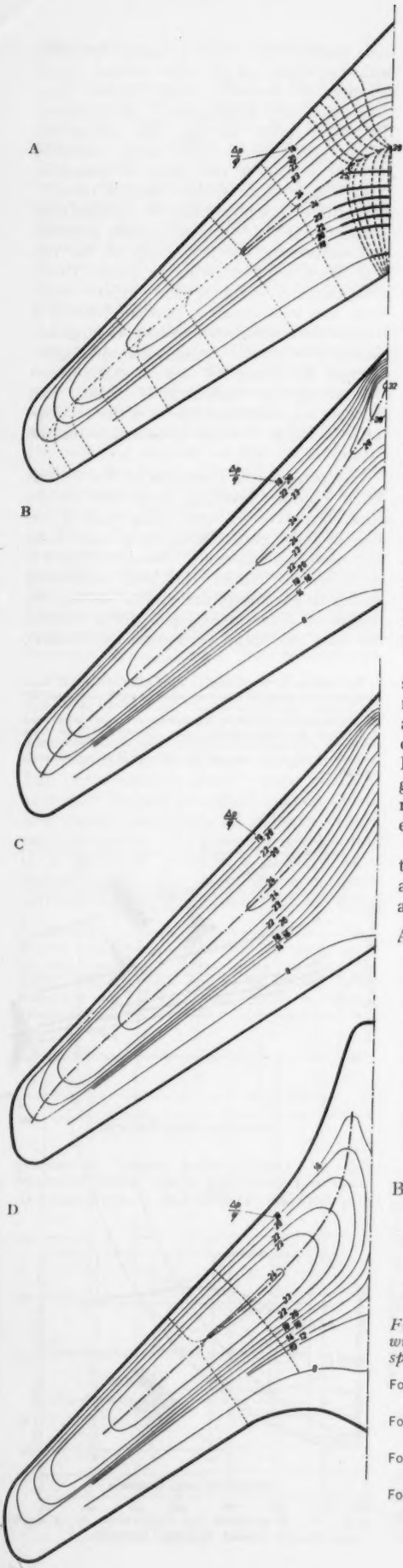


Fig. 15 : Maximum lift coefficients of a high-speed profile versus profile thickness :



at the same time maintaining the sweep effect by forward displacement of the centre section and of the maximum profile thickness.

In this type of design, the air intake of the turbojets also plays an important rôle. Installed at the point of the arrow (sweep-back), it can play an important part in the reduction and forward translation of the local supersonic speeds. At the same time, Form V also permits a considerable enlargement of the useful space in the middle section ; in addition, it has proved practical in connection with the distribution of lift (indiced drag).

In the outer sections, unimportant from the point of view of the utilization of space, the percentual thickness should not be chosen too thin (about 12%) corresponding to aerodynamical considerations, in order to ensure practical maximum lift coefficients (Fig. 15), good control effect and favourable stalling behaviour. With regard to the critical Mach number, reserves are still present with an 11% to 12% profile thickness owing to a pronounced sweep-back. This is also advisable inasmuch as Mach disturbances at the wing tips can have especially unfavourable effects owing to the large leverage and the ailerons.

In designing a flying wing the fields of supersonic speed are calculated by approximation methods for various lift coefficients and then presented graphically in the form of pressure layer lines (direction of shock; Fig. 16). At a more advanced stage of progress in the projected type, the calculated results can be checked by wind tunnel experimentation.

The sketches A to D of Fig. 16 indicate the stages of development leading to Form V and are the result of approximation methods and estimations :

A : In the case of a trapezoidal periphery of constant percentual thickness (12%) and of constant position of maximum thickness (40%) the layer lines are displaced to the rear as a result of the " Middle effect ", with the result that the pressure drop (over a broad section of the wing) remains parallel to the direction of flight. In consequence the formation of shocks is not delayed in this domain by the effect of backward sweep.

B : By means of forward placing of the maximum profile thickness of the centre section (from 40% to 20%), the peak of maximum suction of this part is again displaced forwards, so that the sweep effect (angle between pressure drop and flight direction) reaches practically throughout the whole of the span. The value of maximum suction ($\Delta p/q$) increases considerably with forward placing of the thickness.

C : By means of this type of forward placing and by simultaneous reduction of the profile thickness (from 12 % to 10 %), the pressure layer lines of the centre section are displaced forwards. The $\Delta p/q$ level of the outer wing sections is retained also on the centre section.

D : If the centre section of the flying wing is more pronounced — owing to periphery and profile design, three-dimensional flow and transverse streaming (in the case of a central air intake)—then the negative pressures on the centre section are considerably decreased, so that the latter is no longer critical for shock formation.

Fig. 16 : Pressure layer plan of four flying wing forms of the same sweep-back and wing span.

Form A : Basic wing of constant percentual profile thickness (12%) and constant position of maximum thickness (40%).
Form B : As compared with Form A, the position of max. thickness in the center section is placed forward from 40% to 20%.
Form C : As compared with Form B, the percentual thickness in the center section is reduced from 12% to 10%.
Form D : As compared with Form C, the negative pressures ($\Delta P/q$) ih the center section are reduced still further by means of : Three-dimensional flow (1), thinner percentual profiling (2), and a central air intake to the turbojets (3).

It goes without saying that the result of this development must be tested by means of high-speed trials and, if necessary, improved.

The elimination of the tail unit brings other problems. In the case of Form V it is possible to replace the elevator unit by installing elevators on the wing, provided that the lift-increasing flaps remain sufficiently limited to prevent a too large pitching moment when extended. Limitations put on the span of the landing flap by elevons or by separate elevators and ailerons are to some extent compensated by the fact that the landing flap can be continued on through the centre section (contrary to the case in aeroplanes with a fuselage). The considerably smaller maximum lift coefficients of the flying wing are compensated by the smaller wing loading. This latter—and the high flying speed—leads to small lift coefficients at high cruising speeds (0.22 to 0.25), which is of essential importance in the attainment of large Mach numbers.

As regards its stabilizing effect, the rudder unit is replaced by the sweep of the wing, at least in the case of large angles of incidence. In this case, the additional stabilizing influence of a fin is hardly desirable, since it impedes the correction of large angles of crabbing. Otherwise very large rudder surfaces would be necessary. Hence, the elimination of the fin results in favourable characteristics at high lift coefficients. On the other hand, stabilization at small lift coefficients—especially during high-speed low-level flight—becomes necessary. The rudder effect — and with it artificial stabilization by means of an automatic pilot—is obtained in the case of aircraft of large span by means of drag flaps on the wing tips (Horten IV and Northrop XB 49). Comparative investigations show that in the case of Form V (with small aspect ratio) a rudder without fin proves to be the most efficient solution.

The aerodynamical and flutter problems in this connection, particularly with regard to the changes in pressure distribution at high Mach numbers, are of great difficulty.

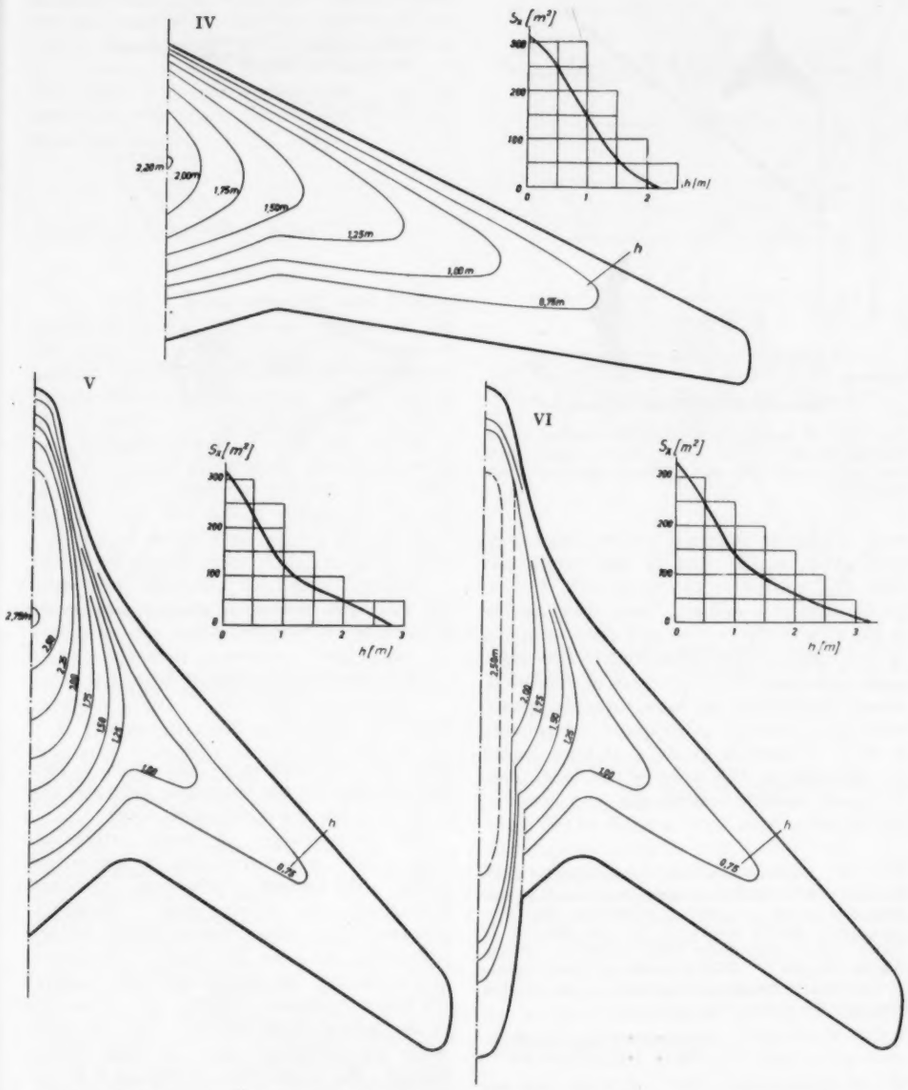


Fig. 17 : Thickness-layer plans for flying wings of wide span and of compressed construction with 312 sq. m. wing area.

Form IV: Large span and 18 % profile thickness
Form V: Small span and 12.5 % profile thickness
Form VI: Compromise solution of 12.5 % profile thickness

Nevertheless, they have been solved. The finless rudder for Form V requires about 3 % of the wing area—as compared with 8 % to 15 % in the case of conventional rudder units. As for the installation of the rudder, the plane of symmetry, the wing tips or a position between them can be taken into consideration. In the case of the commercial transport aircraft, the central position—as compared with a double installation on the outboard wing sections—seems to be superior with regard to flutter, stability, simplicity of control and aerodynamics.

The Problem of Space

The utilizeable space of an economic transport aeroplane must be designed in magnitude and form so as to house a large part of the payload with sufficient comfort in the case of passengers. With increasing range, the payload of an aeroplane and consequently the dimensions of its required useful space (for identical comfort) diminishes. In the case of the considerable flying time reductions listed in the timetable to Fig. 1, an increase in comfort as compared with to-day's long-range transports would not seem necessary for the very fast transoceanic aircraft.

With identical comfort, the number of transportable passengers in the intercontinental transport is 25 % to 35 % higher than that of the transoceanic aeroplane, at equal power plant performance. Hence, passenger cabins and other rooms must be presumed to be correspondingly larger in the intercontinental transport than in its transoceanic sister. However, should an intercontinental aeroplane be equipped with such large cabins—for instance by redesigning Type VI with a larger or two-story fuselage—it remains of little practicability for the transoceanic non-stop flight. The payload (as compared with the transoceanic aircraft with a correspondingly smaller usable space) would be reduced considerably owing to the unnecessary additional weight and resistance.

The most favourable solution seems to be arrived at when the entire useful space of the transoceanic aeroplane can be located in the central portion of a flying wing, so that no additional drag results. The relatively small payload of a transoceanic aircraft makes it possible to house this payload in a compressed flying wing type (Form V) of still reasonable size, or then in Form VI of minimum dimensions.

Space Utilization in the Flying Wing.

The possibilities offered by a flying wing with regard to the housing of passengers can be estimated according to the following procedure : Layer lines of equal thickness are drawn up in the aircraft plan form and planimetrically measured (Fig. 17). Experience has shown that the area (S_e) enclosed by a layer line for a thickness of 2 m. gives a practical measure for the estimation of the cabin floor area.

If the cabin floor area (S_e) is compiled in correlation with the wing area (S) and the percentual profile thickness (parameter δ) (Fig. 18), it can then be seen that the flying wing can be operated as a transport aircraft only when a sufficiently *large* aeroplane is built. Form IV can be realized only with large profile thicknesses (of the order of 18 % to 20 %). Considerably more favourable profile thicknesses (of the order of 12 % to 14 %) can be realized by the use of a very compressed Form (V).

As a measure for the percentage of cabin floor area versus wing area we introduce

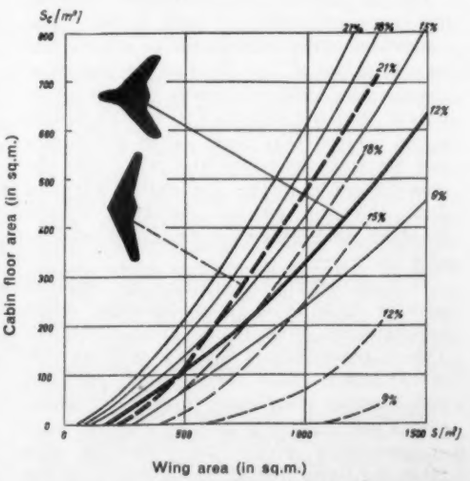


Fig. 18 : A comparison of the utilizeable cabin floor space (S_e) of flying wing types of both wide span and compressed form at increasing wing areas (S) and varying wing thicknesses (δ).

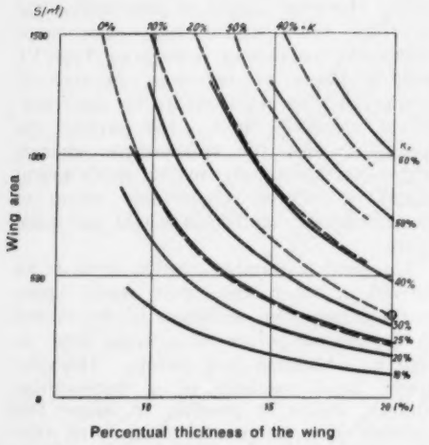


Fig. 19 : The percental utilization of the floor area (K) in flying wings of both wide span and compressed form in correlation with the size and percental thickness of the wing. Continuous curves apply to the compressed form; broken curves to the wide span type. K (%) = 100 S_c/S.

$K = 100\ S_c/S$. Fig. 19 shows value of K in relation to percentage of thickness and area of the wing both for flying-wing forms IV and V.

As can be noticed, the percentual profile thickness has to increase pronouncedly as the wing becomes smaller in order to fulfill a specific space requirement designated by K. — The course of the nest of curves, it is true, is similar for both forms, yet the curves for the type with large aspect ratio and for that with the compressed form have very dissimilar parameters. Thus, for instance, the curve $K = 0$ % of the design with large aspect ratio (IV) coincides with $K = 25$ % of the compressed form (V) ; in a similar fashion, the curve $K = 20$ % for the large-span type coincides with $K = 40$ % for the compressed type. Hence, if a specific utilization K is attained in the large-span form, then this can be increased to a considerably higher percentage through conversion into the compressed form (without altering S and δ).

Fig. 20 presents the correlation between the space utilization of both forms. The continuous curve corresponds to a layer line for a thickness of 2 m. limiting the passenger space. The series of crosses correspond to 1.50 m. and the dots to 2.50 m. From this it can be seen that these values practically coincide with the curve, and hence that the laws derived by virtue of a limiting curve of 2 m. thickness are not essentially altered by other suppositions concerning the utilizeable thickness.

If it is desired to construct the smallest possible flying wing types, passenger space requirements have to be greatly limited. This is automatically the case with aircraft of maximum range (hence small payload) and becomes even more pronounced whenever a part only of a payload is in the form of passengers whilst the remaining part takes the form of mail, i.e. is housed in the lower holds. In this case, space requirements begin to approximate those of a bombing aeroplane. In the limiting case ($K = 10$ %), a wing of 330 sq.m. with 20 % profile thickness would be required in the large-span form (IV) ; in the case of the compressed form (V), a wing of 215 sq.m. with 13.5 % profile thickness suffices. Thus, it is possible in the case of the compressed form to arrive at two thirds of the dimensions of the large-span type—as well as to obtain profile thicknesses appropriate to high subsonic speeds with simultaneously pronounced sweep-back. A space utilization of 30 % at least would be desirable in the case of the long-range transport aircraft. With this end in view, and in both cases, *large* aircraft of 660 sq.m. wing area are necessary—with a 20 % profile thickness for the large-span type and one of 13.5 % for the compressed form.

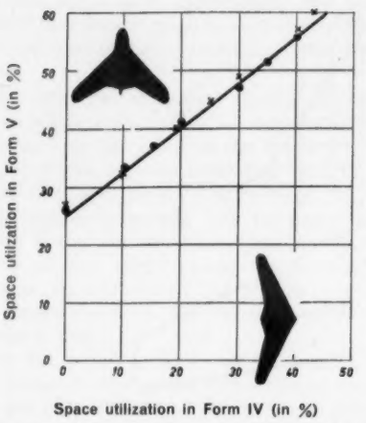
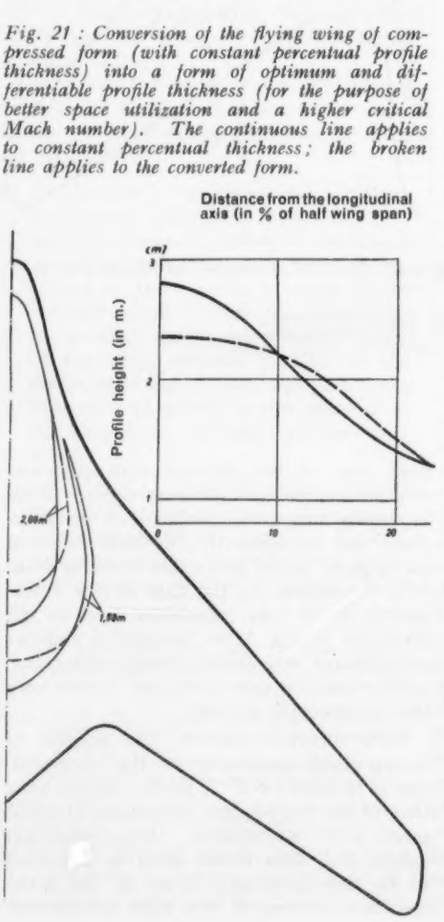


Fig. 20 : A comparison of the percentual space utilization (K) of the flying wing of wide span type (abscissa) with that of the compressed form (ordinate).

Fig. 21 : Conversion of the flying wing of compressed form (with constant percentual profile thickness) into a form of optimum and differentiable profile thickness (for the purpose of better space utilization and a higher critical Mach number). The continuous line applies to constant percentual thickness; the broken line applies to the converted form.



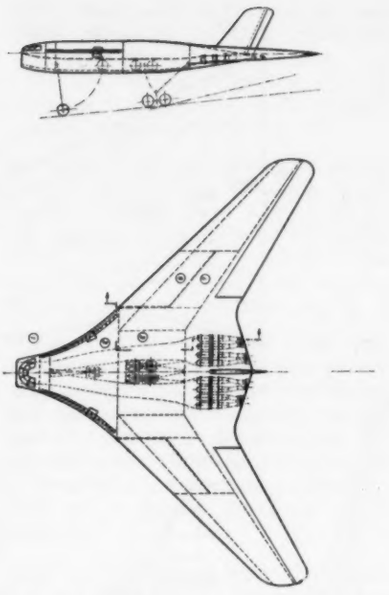


Fig. 22 : Space utilization of a very large flying wing of the compressed type.

1 pilot cabin
2 passenger and promenade deck
3 lounges, cabins and adjoining rooms
4 cargo and luggage holds
5 fuel compartments

The investigation of space utilization (Figs. 17-20) was carried out for percentual profile thicknesses remaining constant throughout the whole span. However, experience has shown that at points located sufficiently far from the plane of symmetry of the aircraft, the profiles can be somewhat thickened without causing any reduction in the critical Mach number. Fig. 21 represents an alteration such as this on the frontal area (reduction of thickness in the plane of symmetry and greater thickness in order to obtain greater cabin width between 10 and 20 per cent. of the semi-span) for the compressed form.

Constructional Questions

Finally, in addition to the problem of space (outlined by means of the layer-thickness method) and the Mach problem (outlined by means of the pressure-layer method), we have the question of the constructional design of the form, which necessitates a number of alterations in the shaping as compared with the "ideal form".

In the case of very large flying wings, either a two-deck arrangement can be chosen, or the air for the turbojets can be canalized by means of intakes leading below the cabin to the rear. A two-deck arrangement such as this would require more than 700 sq.m. in the case of the compressed form and more than 1200 sq.m. in the case of the large-span type, as regards wing area. In a projected compressed form (V) with a wing area of about 110 sq.m., either the air canals leading to the turbojets together with the central

undercarriage, or additional useful space for passengers (bar, kitchen, toilet facilities) can be placed below the main cabin. Aircraft of the compressed type and of this order of size offer ideal spacial relations. Fig. 22 represents the space distribution of such a giant aeroplane.

Flying wing compromise types

An " ideal " flying wing (V) such as that presented in Fig. 22 would surpass by far the order of to-day's commercial transport aircraft with its take-off weight of approximately 280 tonnes. Inasmuch as the present aim is merely to design long-range commercial transports with a take-off weight of 60-120 tonnes, the size of the flying wing is at present limited to 250-500 sq.m. This means that the space utilization in the compressed flying wing type of 12% average thickness ranges from 11% to 25% only even with optimum thickness distribution. Even with maximum ranges, this does not suffice for the transportation of a sufficiently large number of passengers ; hence, the aircraft would be restricted to the carriage of cargo or mail.

If the construction of a pure passenger transport aeroplane is desired, taking into account this limitation of the flying wing size, it then becomes practical to place greater emphasis on the center section than is already the case in the compressed form, so that a *fuselage body* starts to take shape. This flying wing compromise design (VI) can, assuming correct form and position of the central body, attain the same critical Mach number as the " pure " flying wing type. The aerodynamic disadvantage as compared with the pure form consists merely in the fact that the additional fuselage area increases obnoxious drag, without contributing towards a reduction of the induced drag and the minimum speed by means of increased wing area.

At this point, the opinion could be maintained that with the addition of a fuselage the idea of the flying wing has been abandoned to the point where the project could be accomplished on the basis of the conventional aircraft type with equal or greater success. However, this would be an error of logic : In the case of the compressed form developed for the flying wing, sufficient space of adequate constructional height remains in the wing sections adjacent to the fuselage for the purpose of housing undercarriage, power plants and fuel tanks. — In the case of a classical design, on the other hand, a considerably larger and heavier fuselage would be necessary for the installation of landing gear and fuel tanks, as well as for the emplacement of the tail unit. As a consequence,

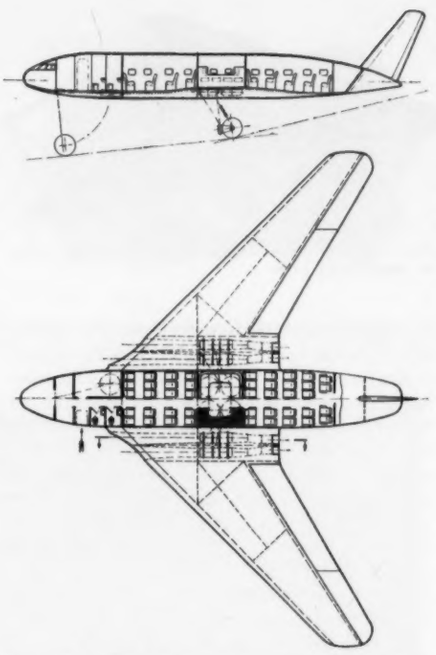


Fig. 23 : General arrangement drawing of a minimum project of 210 sq.m. wing area on the basis of the flying wing of compressed form ; power plant consists of four ATAR 101 B turbojets.

Main data : aspect ratio 4.5
sweep-back 45°
maximum profile thickness 12%
drag coefficient 0.0083

additional obnoxious drag would result from the enlargement of the fuselage, the tail unit and the engines mounted in part or even entirely within the air stream. Finally, it should be mentioned that the finless rudder developed in conjunction with the flying wing conception is for practical reasons to be retained even when a central fuselage body for passenger cabin purposes is added.

The *minimum size* of a flying wing compromise aircraft (Form VI) depends on the number of passengers (1), on the smallest possible wing size (2) and on the number of turbojets (3). Limitation to four turbojets is probably the maximum to be obtained, having regard to the possibility of engine failure, and in any case requires considerable fuel reserves. A solution with six turbojets would be more advantageous. The minimum project is sketched out in Fig. 23. That this form and size permits good invisible engine installation can be seen from Fig. 24.

For the analysis of projects, development of which to the point of practical operation requires a great deal of time, it would be erroneous to reckon with to-day's performance and consumption figures for a type of power plant which is still undergoing rapid development. In the present case, an increase in thrust of 20% and a decrease in consumption of 12% as compared with the present values for the ATAR 101 B were assumed for the " end stage ". Even then, these consumption figures remain considerably lower than those cited in present literature as being attainable in the near future. The static consumption assumed in the end stage amounts, for instance, to 1.0 kg/km.p.h.— instead of 0.9 kg/km.p.h. as quoted in the scientific journals. For reasons of comparison, a number of performance figures with today's ATAR 101 B were calculated for the " preceding stage " (cf. performance table).

PERFORMANCE FIGURES FOR
THE FLYING WING COMPROMISE AEROPLANE

(Form VI) of minimum dimensions, with four ATAR turbojets

		End Stage	Preceding Stage
Empty Weight	(kg)	23,000	22,800
Crew	(kg)	600	600
Payload	(kg)	5,700	4,600
Passengers	(number)	50	40
Fuel	(kg)	28,700	24,000
Take-off Weight	(kg)	58,000	52,000
Cruising Speed	(km/h.)	925	900
Cruising Altitude (average)	(m)	13,000	12,500
Climbing Speed after Take-off	(m/sec.)	10	—
Maximum Range (in still air, without reserves other than landing)	(km)	8,200	6,200
Take-off Distance (with 25% increase in take-off thrust)	(m)	1,400	1,400
Cruising Speed with 3 turbojets *	(km/h.)	825	—
Cruising Altitude with 3 turbojets *	(m)	11,500	—
Maximum Range with 3 turbojets *	(km)	7,200	—

* Failure of one engine at the end of the climb to cruising altitude.

From these data it may be seen that the intercontinental route can be flown with an economically interesting payload even with to-day's turbojet performance and consumption figures, through the development of an aircraft on the basis of the high-speed flying wing appropriate to the modern turbojet with axial compressor. With the improvements which will almost certainly be made to the turbojet within the near future, probably even before such air frames are realized, these aircraft will permit economic transoceanic transportation with very short flying times.

The smaller range of the " preceding stage " is—apart from the larger consumption involved—also caused by the fact that take-off weight and consequently fuel loading had to be reduced considerably for reasons of take-off. A 25% increase in thrust by the use of water-methanol injection was calculat-

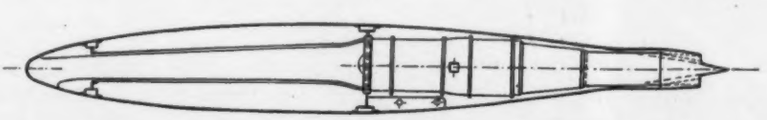


Fig. 24 : Invisible installation of the power plant in the minimum project (Fig. 23).

ed for take-off. Above and beyond this, the further development of the turbojet promises better prospects for thrust augmentation and hence reduction in take-off distance. Mention can be made, as a particularly favourable procedure for increasing thrust, of augmenting the gas temperature before the turbine, a procedure which, for instance, can be envisaged in the case of air-cooled hollow turbine blades.[4]

In the minimum design, the space relation for the accommodation of passengers and the visibility conditions are about the same as in the commercial transport aircraft of the present time. Should a decision be made to construct considerably larger aircraft of the Form V (Figs. 22 and 25), its economy in transoceanic flight will be somewhat increased. In this case, large rooms and a promenade deck would be at the disposal of passengers, providing extraordinarily good visibility.

The calculated payload for the minimum project of about 10% of the take-off weight

[4] Cf. H. Oestrich: "Thrust Augmentation in Turbojets" in INTERAVIA, Review of World Aviation, No. 8, August 1949, p. 484-488.

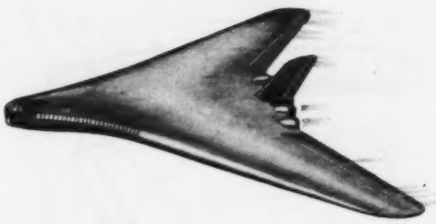


Fig. 25: Artist's drawing of a large flying wing of compressed form.

is very economic for long transoceanic routes, as a result of the high cruising speed. Operational costs for transoceanic schedules are reduced by the pronounced reduction in travelling time (elimination of intermediate landings and high cruising speed). The shorter time of operation of the airframe, power plant and crew contributes considerably to the reduction of operating costs. In addition, the reduction in personnel resulting from less frequent changing of pilot, wireless operator and navigator and in the servicing of passengers during the shorter flying time can be included as advantages. And the elimination of intermediate landings results in a reduction of airport costs, quite apart from gains in distance and time. Detailed economic calculations show that operating costs for transoceanic transportation per passenger seat are smaller with the suggested jet-powered high-speed aircraft than with to-day's aircraft of half the cruising speed and correspondingly three times the travelling time. However, they are also less than those involved in the operation of propeller turbine-powered aircraft, which attain about two thirds of this cruising speed.

The abbreviation of flying time to about one third of present-day values will bring the continents closer to one another and in consequence also increase the number of travellers. Since the speedier method of transport is always in greater demand than the slower, assuming equal comfort, equal fares and, of course, equal safety and reliability, the suggested transoceanic high-speed commercial transport aeroplane will undoubtedly result in a particularly favourable load factor.

Present-Day Gas-Turbine Engines

Gas-turbine engines have now held a steady place in aeronautics for about a decade. At first tentatively tested on experimental aircraft, they were enthusiastically accepted in military aviation, and finally—with and without airscrews—in commercial air transportation. A review of the gas-turbine engines available to-day in Great Britain, the U.S.A., France and Canada already includes a considerable number of production types in the performance bracket 1,000 HP to 10,000 HP. New types are being tested and will become operational within a few years. And research is being carried out in all laboratories in order to obtain the fundamentals for still more powerful, more economical and more reliable turbo-engines.

Why are gas-turbine engines advantageous? As compared with the piston engine and compound engine, they possess two recognized main advantages, from which a number of further advantages follow: pure rotational movement—and distribution of the thermal cycle over a number of separate organs.—The pure rotary motion results in vibrationless operation, higher r.p.m., smaller constructional weight, smaller frontal area and extremely small lubricant consumption. And the distribution of the working process over a number of functionally separate organs (compressor, combustion chamber, turbine, jet pipe, and in some cases airscrew) allows these to be specially equipped for their particular task (special materials, the use of heavier fuels with a higher flash temperature, individual and very limited cooling). The total result is hence a considerably simplified design, in association with greater reliability, easier starting (no warming up), operation and maintenance—and a higher upper power limit.

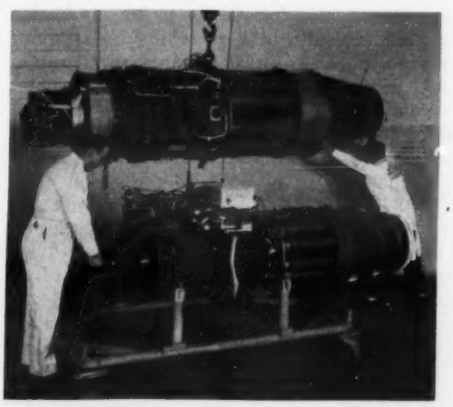


Fig. 1: An American turbojet, the Allison 450 (J-35) of 5,100 lbs. maximum thrust above the Allison 500 coupled airscrew turbine (T-40) of 5,000 shaft HP plus 830 lbs. residual thrust; the latter is shown without transmission shafts, reduction gear and airscrews.

Basic types of turbine power plant

These advantages apply to a particular extent to *turbojets*, which merely convert that portion of the total thermal energy necessary for the operation of the compressor into mechanical work (torque times r.p.m.) and achieve propulsion as such simply through the expansion of the heated and compressed air-gas mixture in the jet pipe.

Propeller turbines (turboprops), on the other hand, have the disadvantage of requiring increased constructional effort and weight in order to obtain the almost complete conversion of thermal energy into mechanical work required from them. In general, they must possess more turbine stages than turbojets, a reduction gear for the airscrew and, of course, the airscrew itself together with its complicated control mechanism. With increasing output, this

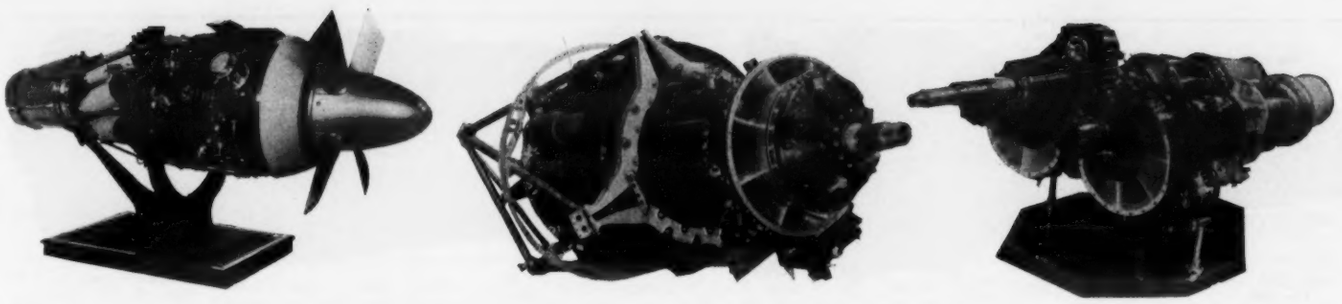


Fig. 2-4 : From left to right : The British airscrew turbines Rolls-Royce « Dart 3 » (1400 HP plus 295 lbs.), Bristol « Theseus 501 » (1975 HP plus 715 lbs.) and Armstrong-Siddeley « Double Mamba » for contra-rotating airscrews (2540 HP plus 770 lbs.).

results in larger and larger percentual weight increase. As opposed to this, airscrew turbines offer other advantages as compared with turbojets : better take-off and climbing performance, lesser fuel consumption—particularly during stand-off at low altitude—and better adaptation within the medium speed range.

Some remarks are helpful for the better comprehension of these characteristics :

(1) Throughout the entire flight speed range (v_{min}—v_{max}) airscrew turbines maintain approximately a constant torque (at a particular r.p.m. and flying altitude) and hence a *constant horse-power* W. For this reason, variable-pitch airscrews allow the possibility of correspondingly increasing thrust at low flying speeds by maintaining the optimum r.p.m. Thus :

$$\text{Thrust (in lbs)} : T = \frac{550 \cdot W. \eta}{v} + T_R \quad (1)$$

where v is flying speed (in ft/sec), η is the coefficient of airscrew efficiency and T_R is the residual thrust of the jet (in lbs).

(2) As compared with this, turbojets show an approximately *constant thrust* throughout the whole speed range (v_{min}—v_{max}) at unchanged r.p.m. and flying altitude. As a consequence, the thrust calculated for high speed is not sufficient for take-off in every case and has to be increased by appropriate measures : stronger power plant,

Fig. 5 : With a 2420-HP shaft performance plus 1210-lb. residual thrust, the French propeller-turbine SOCEMA « TGA-1 bis » balongs to the medium power bracket.

compressive cooling, post-combustion, take-off rockets, etc.

(3) Both types of power plant function the more efficiently the smaller the speed difference necessary for propulsion (c-v) between the masses of air (per second) propelled to the rear by the airscrew or by the pure jet ($\rho\ Q$) and the aircraft itself can be. Thus :

Thrust (change of momentum) in lbs :

$$T = \rho\ Q\ (c\text{-}v) \quad (2)$$

Effective work of thrust per second in ft. lbs/sec :

$$T.v = \rho\ Q\ (c\text{-}v)\ v \quad (3)$$

Necessary work per second in ft.lbs/sec :

$$E = \tfrac{1}{2}\ \rho\ Q\ (c^2\text{–}v^2) \quad (4)$$

The *propulsive efficiency*, i.e. the ratio between the effective work and the mechanical energy produced in the system, therefore amounts to :

$$\eta_v = \frac{T.\ v}{E} = \frac{2v}{c+v} \quad (5)$$

From this it can be seen that the airscrew gas turbine, which propelles a relatively large mass of air $\rho\ Q$ with the airscrew and hence accelerates it only moderately (small c), is better adapted for medium speeds than the turbojet, which has to apply a larger exhaust velocity c to a smaller mass of air and hence is reserved for higher speeds. For it goes without saying that the applied mechanical work E has to be paid for with thermal energy i.e. with fuel consumption.

(4) At constant flying speed, both aircraft drag, i.e. necessary engine thrust T, and the applied work E to produce the thrust decrease with increasing flying altitude corresponding to atmospheric density ρ (equations (2) and (4)). Hence, jet aircraft have to fly as high as possible in order to attain minimum fuel consumption per mile ; in the case of airscrew turbines—owing to decreasing efficiency of the airscrew—medium flying altitudes are to be recommended.

Fig. 6 : The most powerful British airscrew turbine existing, the « Coupled Proteus » (Bristol) for contra-rotating airscrews has a 6,400-HP take-off performance plus 1,600-lb. residual thrust, and will be installed in the Bristol « Brabazon Mk. 2 » and Saunders-Roe « Princess ».

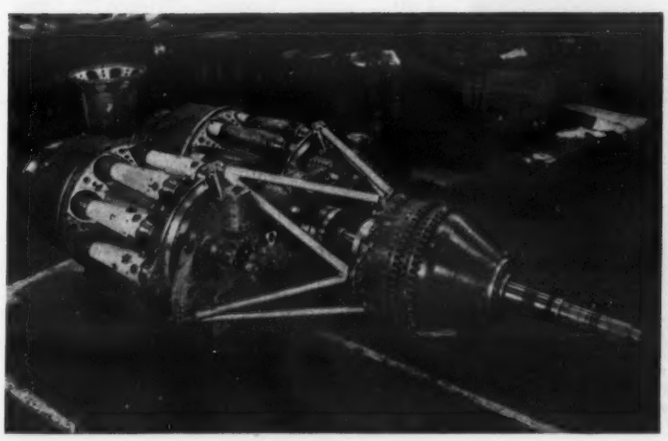
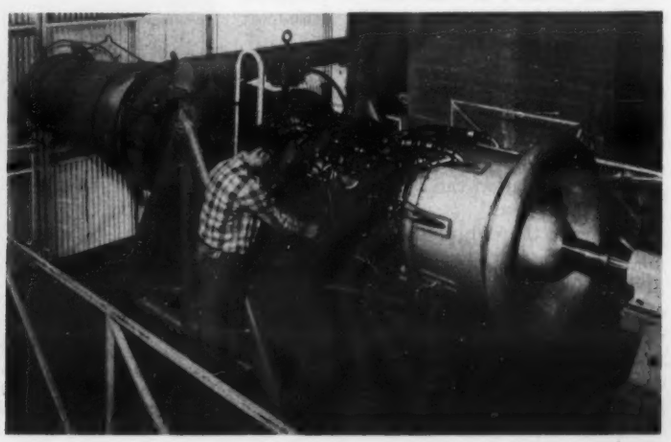


Fig. 7 : The most powerful American airscrew turbine engine, « Turbodyne XT-37 » is still in the experimental stage and develops a maximum of 10,000 shaft HP plus 600 lbs. residual thrust. The blade pitch of the two contra-rotating four-blade airscrews and the engine r.p.m. are to be electronically controlled.



Manufacturer and Model	Take-off power		Max. endurance power			Construction Details					Dimensions		Weights		Remarks
	Shaft H.P. plus thrust (lbs)	at r.p.m.	Shaft H.P. plus thrust (lbs)	at r.p.m.	m.p.h. and altitude	Compressor	Combustion chamber	Turbine	Reduction gear	Airscrew	Diameter in.	Length in.	Dry lbs	Installed lbs	
Rolls-Royce "Dart 1"	1 000 h.p. + 310 lbs	14 500	910 h.p. + 17 lbs	13 000	400 0	2-stage centrifugal 5,5 : 1	7	2-stage	0.091	3 or 4-bladed	38.5	94.8	850	1 080	1300 shaft h.p. plus 310 lbs with compressive cooling.
Rolls-Royce "Dart 3"	1 400 h.p. + 295 lbs	14 500	1 120 h.p. + 250 lbs	14 000	0 0	2-stage centrifugal 5.5 : 1	7	2-stage	0.091	3 or 4-bladed	38.5	98	1 075	—	Power plant of Vickers "Viscount".
SNECMA TB. 1000	1 320 h.p. + 570 lbs	15 400	940 h.p. + 420 lbs	14 000	310 0	9-stage axial —	6	2-stage	0.109	3-bladed	27.5	107.5	1 060	1 430	Equivalent shaft h.p. 1430 (take-off) 1040 (contin.)
Armstrong Siddeley "Mamba 1"	1 010 h.p. + 307 lbs	15 000	918 h.p. + 102 lbs	14 000	300 —	10-stage axial 5.0 : 1	6	2-stage	0.097	3 or 4-bladed	28	57	760	1 060	Fuel consumption at cruising power (per hour) 0,72 lbs/e.s.h.p.
Armstrong Siddeley "Mamba 2"	1 320 h.p. + 405 lbs	15 000	930 h.p. + 135 lbs	14 500	300 10,000'	10-stage axial 5,0 : 1	6	2-stage	0.085	3 or 4-bladed	29	77	770	—	Equivalent shaft h.p. 1475 (take-off) 1065 (contin.).
Armstrong Siddeley "Double Mamba"	2 540 h.p. + 770 lbs	15 000	2 475 h.p. + 200 lbs	14 000	350 —	2×10 axial 5.0 : 1	2×6	2×2	0.097	Contra-rotating 6-bladed	52.8 × 42.4	79.8	2 000	—	Two four-bladed contra-rotating airscrews may also be used.
General Electric TG-100 B (T-31)	1 900 h.p. + 500 lbs	13 000	1 600 h.p. + 450 lbs	13 000	0 0	14-stage axial 5.5 : 1	9	1-stage	0.088	4-bladed	35.1	114.6	2 030*	—	*) including auxiliaries but without airscrew.
Bristol "Theseus 501"	1 975 h.p. + 715 lbs	8 200	1 450 h.p. + 650 lbs	7 800	0 0	8-stage axial plus 1-st. centrifugal 4.4 : 1	8	2 for compr. 1 for airscrew	0.119	4-bladed	54	81.8	2 320	—	Highest equiv. power in tests 2550 h.p.
SOCEMA TGA-1 bis	2 420 h.p. + 1210 lbs	6 550	1 970 h.p. + 1100 lbs	6 350	0 0	15-stage axial 3.6 : 1	Annular	4-stage	0.173	3-bladed	45.3	120	4 630	—	First French designed and built turboprop. airscrew Ø 13 ft 11¼ in.
Armstrong Siddeley "Python 1"	3 670 h.p. + 1150 lbs	8 000	3 260 h.p. + 390 lbs	7 600	300 0	14-stage axial 5.0 : 1	11	2-stage	0.123	contra-rotating 8-bladed	54.5	156	3 150	4 100	Annular air intake ; airscrew diameter 11 ft 0 in.
Armstrong Siddeley "Python 2"	4 100 h.p. + ... lbs	8 000	—	—	—	14-stage axial 5.0 : 1	11	2-stage	0.123	contra-rotating 8-bladed	48	156	2 980	3 950	Twin-duct air intake ; airscrew diam. 11 ft. 0 in.
Allison 501 (T-38)	2 550 h.p. + 415 lbs	—	—	—	—	17-stage axial —	8	4-stage	—	4-bladed	20	84	1 225	—	Max. power in ground tests 3600 shaft h.p.
Allison 500 (T-40)	5 100 h.p. + 830 lbs	—	—	—	—	2×17 axial —	2×8	2×4	—	contra-rotating 8-bladed	—	84	2 500	—	Various sub-versions, depending on length of extension shaft.
Bristol "Proteus 2"	3 200 h.p. + 800 lbs	10 000	—	—	—	12-stage axial + 1-stage centrifug. —	8	2 for compr. 1 for airscrew	0.090	4-bladed	38.5	113.4	2 900	—	Max. power at 35,000 ft, 350 m.p.h., and 10 000 r.p.m. is 1260 shaft h.p. + 560 lbs.
Bristol "Coupled Proteus"	6 400 h.p. +1600 lbs	10 000	—	—	—	2×12 plus 2×1 —	2×8	2×2 plus 2×1	0.084	contra-rotating 8-bladed	80.4 × 38.5	167.3	8 110	—	Each engine drivers both airscrews.
Turbodyne XT-37	10 000 h.p. + 600 lbs	—	about 8000 h.p.	—	—	17-stage axial 7.0 : 1	Annular	4-stage	0.121	contra-rotating 8-bladed	—	—	—	—	Experimental ; Electronic control box.

Table I *Propeller-turbines*

Propeller turbines

Half of the 16 airscrew turbine engines listed in Table I are installed or projected for installation in commercial transport prototypes. This is the case with the "Dart", "Mamba", "Theseus", "Allison T-38", "Proteus" and "Coupled Proteus". The remainder are operating in military aircraft (trainers, carrier fighters, flying-boats) or are still undergoing trials. Nevertheless, later civil operation can be envisaged in the majority of cases.

Of these, the only type to be fitted out with a (two-stage) radial compressor is the Rolls-Royce "Dart" (Fig. 2). In the case of the more powerful types, axial compressors (nine to seventeen stages) are the rule (Figs. 1, 4, 7), if not tandem compressors—consisting of an axial compressor (of high volume-flow characteristic) and of a subsequent radial compressor (of high pressure-rise characteristic)—are utilized (Fig. 3). At present, the compression ratio lies between 5.0 and 5.5, but will probably undergo a considerable increase by the introduction of new types of compressor within the next few years.

A number of engines are equipped with mechanically separate turbine wheels for the airscrew drive ; thus the types "Theseus", "Proteus" and "Coupled Proteus" of Bristol. Here the airscrew drive shaft runs through the hollow compressor shaft. In three cases ("Double Mamba", "Allison T 40" and "Coupled Proteus"), two engines are combined in parallel and connected by means of a common reduction gear for contra-rotating airscrews (with reversible pitch), as can be seen in Figs. 1, 4, 7. In the case of the "Allison T-40" (to T-38), even relatively long—though rapid-turning and hence slender—transmission shafts are installed from both power plant halves to the reduction gear.

A four-group version of this power plant ("Turbo-Quad" with four T-38) is now in development ; it is to attain a maximum equivalent shaft power [1] of approximately 11,000 HP at a weight of 4,500 lbs (without airscrew and reduction gear) and a fuel consumption of 0.63 lbs/h.p.h.

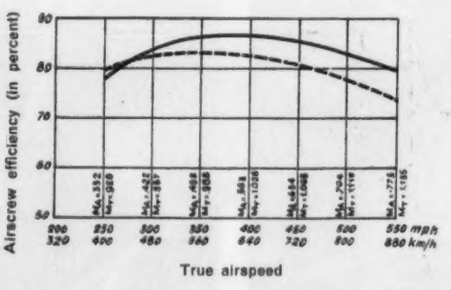


Fig. 8 : Efficiency of thin-bladed airscrews (continuous curve) and normal standard blade airscrews (broken curve) versus true flying speed ; M_A is the Mach number of the aircraft, M_T the Mach number of the airscrew blade tip.

[1] Account being taken of the residual thrust.

Fig. 11 : SNECMA (France) « Atar 101 B » (with annular combustion chamber) for a maximum thrust of 5,000 lbs. to 6,000 lbs.

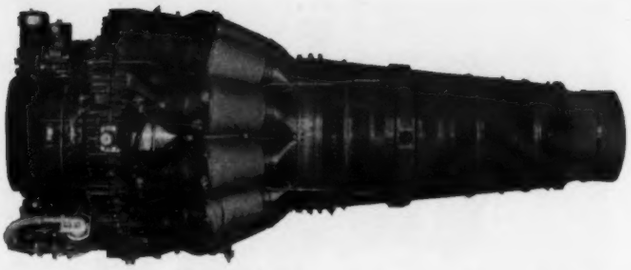


Fig. 12 : De Havilland « Ghost » (with unilateral radial compressor) the power plant of the De Havilland D.H. 106 « Comet » developing a static thrust of 5,000 lbs.

In general, the fuel consumption of to-day's airscrew turbines is about 0.70 lbs/e.s.h.p. and hour and is therefore about 50% higher than that of piston engines. This disadvantage—probably not all too easily to be eliminated—is more than compensated by cheaper fuels (kerosene), higher cruising speed (passenger-mile performance) and lower power plant weight (about 50% as compared with piston engines), at least over short and medium ranges.

Of particular importance is furthermore the fact that the propeller blades of airscrew turbines can be designed considerably thinner as a result of their vibrationless rotation, and hence show greater efficiency at high speed. Fig. 5, for which we are indebted to a paper by *L.H. Enos* [2] (Curtiss-Wright Corp.), shows what excellent efficiency can be expected from a thin-bladed airscrew of this type even at flying speeds of 500 m.p.h. to 550 m.p.h.

Turbojets

All of the 20 types of Table II are practically exclusively operated in military aviation (fighters and high-speed bombing aeroplanes). So far, only two have been utilized for civil purposes : the De Havilland " Ghost " (D.H. " Comet ") and the Rolls-Royce " Derwent V " (Avro Canada " Jetliner "). In the meanwhile, the types " Allison 400 " (J-33), P. & W. JT-6B " Turbo Wasp " (J-42, the American licensed production of the Rolls-Royce " Nene ") and Westinghouse 24 C-4B (J-34) have been certified for civil operation by the C.A.A.

Consideration of to-day's types shows a clear division into 5 categories :

(1) Turbojets in the medium power bracket with axial compressor (Fig. 9)
(2) Turbojets in the medium power bracket with radial compressor (Fig. 10)
(3) Turbojets in high power bracket with axial compressor (Figs. 11)
(4) Turbojets in high power bracket with radial compressor (Fig. 12, 13, 14)
(5) Turbojets in highest power bracket with axial compressor (Figs. 15 and 16)

Whereas the advantages and disadvantages of axial compressors and radial compressors with single-sided (D.H. " Goblin "

[2] Presented in October, 1948, at the S.A.E. Symposium in Los Angeles on the theme : The Long-range Overseas Transport Plane of 1955.

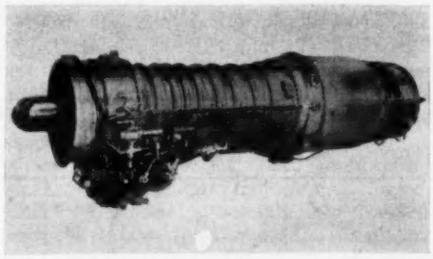


Fig. 9 : Westinghouse 24C-4B (J-34) with axial compressor and annular combustion chamber, developing a static thrust of 3,000 lbs.

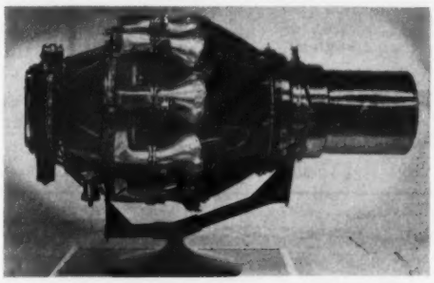


Fig. 10 : Rolls-Royce « Derwent 5 » (with double-sided radial compressor) the power plant of the Avro C.102 « Jetliner », developing 3,600 lbs. static thrust.

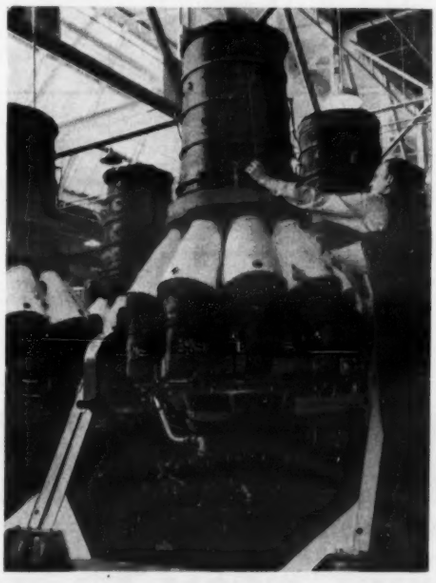


Fig. 13 : Production assembly of the « Turbo Wasp JT-6B » or J-42 at Pratt & Whitney in East Hartford (Conn.) under license by Rolls-Royce (« Nene »).

and " Ghost ") or double-sided (R.-R. " Derwent ", " Nene ", " Tay ") impeller more or less balance out at thrust performances between 3,000 and 6,000 lbs., the axial compressor is definitely superior at higher thrust. An increase to higher values of present-day compression ratios (3.5 to 6.8) would probably necessitate a tandem arrangement of two or more compressors with independently operating drives through separate turbine wheels. Meanwhile, only turbojets with radial compressors have come into use in civil aviation, owing to the generally held opinion that they are more reliable (with regard to icing of compressor and maintenance) and permit easier tapping for the purposes of cabin pressuration, and thermal de-icing of wings and empennage.

In many types, measures for thrust augmentation are carried out, notably short-term injection of a water-methanol mixture into the compressor intake (compressive cooling) or into the combustion chambers. However, there are also—designed exclusively for military aircraft—arrangements for post-combustion, i.e. for the additional injection of fuel in the extended jet pipe (afterburner), which can be operated both at take-off and in flight (Fig. 14). For instance, both measures applied simultaneously in the Pratt & Whitney J-48 " Turbo Wasp " (the American licensed production of the R.-R. " Tay ") achieve a maximum thrust of nearly 8,800 lbs , whilst the " dry " maximum thrust amounts to 6,200 lbs. only. A maximum thrust of 8,800 lbs. at 670 m.p.h., today's world speed record, corresponds to an effective propulsion power of 16,000 HP ; at a take-off speed of 170 m.p.h., however, it equates to about 4,000 HP only. It should be noted, however, that the J-48 " Turbo Wasp ", together with its large post-combustion chamber, is almost 19 ft. long.

The fuel consumption of to-day's turbojets with axial compressors lies between 0.95 and 1.10 lbs. per lb. thrust and hour, and with radial compressors is about 10% higher. In the first jet engines (e.g. Jumo 004) it was almost double. Further economies—even though to a lesser extent—can be expected as soon as on the one hand the compression ratio can be successfully increased (up to values about 20), and on the other hand the gas temperature at the turbine intake can be correspondingly augmented. At present this latter is in the neighbourhood of 750° C. and could attain 900° C., 1000° C. or even more as soon as high-temperature resistant

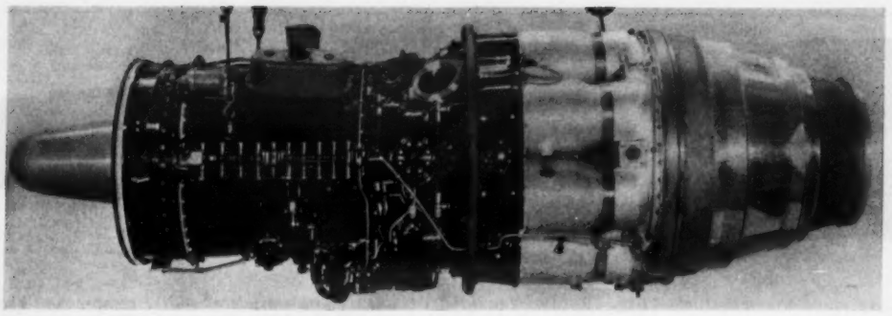


Fig. 15 : Rolls-Royce « Avon 2 », until recently the most powerful British turbojet, develops a maximum static thrust of 6,000 lbs. at sea-level.

Fig. 16 : Avro Canada « Orenda », the most powerful Canadian engine, also probably develops 6,000 lbs. thrust—or more.

Manufacturer and Model	Take-off thrust		Max. continuous thrust			Construction details			Dimensions		Dry Weight	Remarks
	lbs.	at rpm	lbs.	at rpm	mph and altitude	Compressor	Combustion Chamber	Turbine	Diameter in	Length in	lbs.	
Armstrong Siddeley " Adder "	1,100	15,000	740	14,250	400 sea level	Axial 10 stages —	6	1 stage	—	73.3	550	Jet version of A.S " Mamba ".
Westinghouse 19XB-2B (J-30)	1 600	17,000	1,235	15,700	0 sea level	Axial 10 stages 3.8 : 1	1 Annular	1 stage	19.0	94.0	710	Developed from Westinghouse 19 A " Yankee " (1943).
Westinghouse 24C-4B (J-34)	3,000	12,000	—	—	—	Axial 11 stages —	1 Annular	2 stages	24.0	120.0	1,200	Thrust-increase to 3150 lbs (dry) and 3600 lbs (compressive cooling) reported.
De Havilland " Goblin 3 "	3 300	10,750	2,240	9,500	0 sea level	Centrifugal 1 stage 3.5 : 1	16	1 stage	49.9	100.5	1,550	" Goblin 2 " : 3000 lbs. max. thrust ; " Goblin 4 " : 3600 lbs. max. thrust ; built under licence by Svenska Flygmotor.
Rolls-Royce " Derwent 5 "	3,600	14,700	3,000	14,000	0 sea level	Centrifugal 1 stage 4.0 : 1	9	1 stage	43.0	83.1	1,280	Double-sided impeller ; 3900 lbs. thrust during bench tests reported.
Allison 400-C4 (J-33)	3,825	11,500	3,280	11,000	0 sea level	Centrifugal 1 stage 4.1 : 1	14	1 stage	50.5	103.0	1,810	Thrust-increase to 4600 lbs (dry) and 5400 lbs. (compressive cooling) reported.
Metropolitan-Vickers " Beryl 1 "	3,850	7,750	3,400	7,400	0 sea level	Axial 10 stages 4.0 : 1	1 Annular	1 stage	37.2	159.0	1,750	Power plant of jet-fighter flying-boat Saro SR/A1.
SNECMA ATAR-101B	4,850	8,050	4,400	7,800	0 sea level	Axial 7 stages 4.2 : 1	1 Annular	1 stage	34.9	112.0	1,875	Variable-area exhaust nozzle ; thrust increase to 5950 lbs. reported.
SOCEMA TGAR-1008	4,850	6,600	4,190	6,400	0 sea level	Axial 8 stages 3.7 : 1	1 Annular	1 stage	40.5	153.5	2,750	Variable-area exhaust nozzle ; experimental power plant.
Allison 450 (J-35)	5,000	7,800	4,255	7,400	0 sea level	Axial 11 stages 4.0 : 1	8	1 stage	37.5	145.0	2,425	Originally developed by General Electric for 3750 lbs static thrust.
General Electric TG-190 (J-47)	5,200	7,950	3,700	7,000	0 sea level	Axial 12 stages —	8	1 stage	36.75	144.0	about 2,500	Max. static thrust with compressive cooling : 6000 lbs.
De Havilland " Ghost 2 "	5,000	10,250	3,975	9,500	0 sea level	Centrifugal 1 stage 4.3 : 1	10	1 stage	53.0	115.5	2,010	Version yielding 5200 lbs. static thrust built under licence by Svenska Flygmotor.
Rolls-Royce " Nene 2 "	5,000	12,300	4,600	12,000	0 sea level	Centrifugal 1 stage 4.0 : 1	9	1 stage	49.5	96.8	1,715	Double-sided impeller ; 5500 lbs. static thrust with compressive cooling ; built under licence by Hispano Suiza (France) and Pratt & Whitney (USA).
Pratt & Whitney JT-6B (J-42) " Turbo Wasp "	5,000	12,300	2,700	10,500	0 sea level	Centrifugal 1 stage 4.3 : 1	9	1 stage	49.5	96.8	1.715	American version of " Nene " ; 5750 lbs static thrust with compressive cooling.
Rolls-Royce " Tay 1 "	6,250	—	—	—	—	Centrifugal 1 stage —	9	1 stage	50.0	96.8	about 2,000	Double-sided impeller ; built under licence by Pratt & Whitney.
Pratt & Whitney JT-7 (J-48) " Turbo Wasp "	6,250	—	—	—	—	Centrifugal 1 stage —	9	1 stage	50.0	96.8	about 2,000	American version of " Tay ". 8800 lbs. static thrust with compressive cooling & after burner of 10ft. length.
Rolls-Royce " Avon 2 "	6,000	—	—	—	—	Axial 5 stages —	8	—	—	—	about 2,400	" Avon 3 " with higher thrust under development.
Avro Canada " Orenda "	6,000+	—	—	—	—	Axial 9 stages —	8	1 stage	—	—	—	Developed from Avro " Chinook " (2600 lbs. static thrust at 10 000 r.p.m.).
Rateau SRA -101	7 275	9,500	5,070	8,800	0 sea level	Axial 10 stages 6.8 : 1	12	2 stages	43.25	143.7	2,200	Variable-area exhaust nozzle ; 8820 lbs. static thrust with after-burner.
Armstrong Siddeley " Sapphire "	7,200+	—	—	—	—	Axial — —	1 Annular	—	32.25	133.85	2,500	Military 150 hours test run concluded ; originally developed by Metropolitan—Vickers.

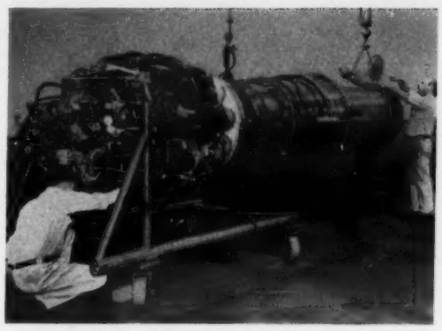


Fig. 14 : Pratt & Whitney J-48 « Turbo Wasp JT-7 » (licensed Rolls-Royce « Tay ») engines with post-combustion chamber for a maximum thrust up to 8,800 lbs. are powering the Grumman F9F-5 and North American F-93-A jet-propelled fighters.

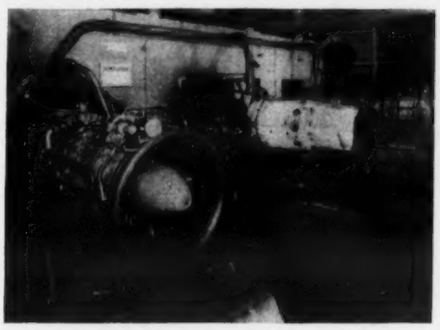


Fig. 17 : SOCEMA « TGAR 1008 » turbojets on the test bench.

or adequately cooled turbine blades are available. Tests at present being undertaken with ceramic or ceramic-coated turbine blades and stator blades as well as with air-cooled (Atar 101 B) and water-cooled blades (circuit cooling or evaporative cooling) are tending in this direction. This would entail at the same time a considerable gain in thrust (cf. Fig. 18) as well as better high-altitude performance. In addition, heat exchangers, as proposed by Ritz, can help to decrease consumption.

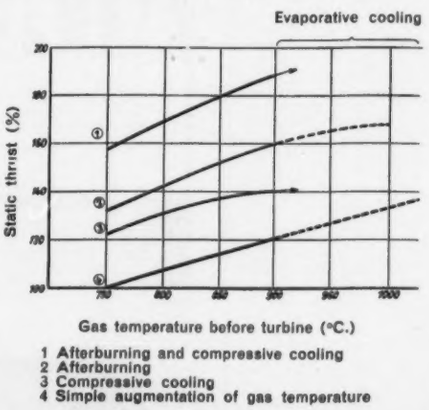
To-day, the life expectancy and operational duration between two overhauls (600 hours in the case of the " Goblin ") with turbojets and airscrew turbines is already very high. Well-aired combustion chambers of chrome nickel alloys attain operational times of 300 hours and more ; the compressors about 1,000 hours. A number of types have reached non-stop operating times of 100 hours (" Derwent 5 ", " Atar 101 B "), 150 hours (" Turbo Wasp JT-6B ", " Orenda ") and even 250 hours (" Goblin ") without any overhaul or maintenance. During a 500-hour operation of the " Goblin ", the entire maintenance time amounted to only 13 hours ; an Avro " Orenda " ran a total of 784 hours on the test-bench—without any particular overhaul with the exception of combustion chamber replacement and the substitution of a number of fuel hoses. In view of the higher mile output of the turbo-engines in actual flight, these latter have therefore already attained the maintenance and overhaul costs of the best piston engines.

Turbo-engines of the future

With the giant power plants Turbodyne XT-37 (of 10,000 HP) and " Turbo Quad " (of 11,000 HP), airscrew turbines have probably attained their maximum performance for the moment. Further output increases are thinkable only as soon as airscrews will have succeeded in breaking through into the supersonic range. Supersonic " *Unducted fans* ", directly coupled with the turbine wheel, would show considerably smaller diameters than infra-sonic airscrews of equivalent performance and eliminate the heavy reduction gears.

But even to-day Westinghouse (J-46), General Electric (J-53) and Pratt & Whitney (J-57) are working on the development of high-performance turbojets with a thrust of 10,000 lbs.—or more—and are subjecting their first experimental prototypes to bench tests. Analogous developments are being carried out by Wright, who are at present constructing a jet turbine engine (TJ-7) with a thrust of as much as 12,000 lbs.

Fig. 18 : Attainable thrust augmentation versus gas temperature at the turbine entry (according to Dr. H. Oestrich, SNECMA, Paris).



In the lowest power brackets there are a number of engines undergoing tests and to a certain extent production. This is the case with the gas turbines Turboméca "Orédon" (140 HP) and "Artouste" (280 HP) for the operation of aircraft equipment and possibly airscrews; the Boeing 502 airscrew turbine (200 HP plus 50 lbs. at 38,000 r.p.m.) and the Boeing 500 turbojet (150 lbs. thrust), the Turboméca " Piméné " (200 lbs. thrust) and Flader XJ-55 (770 lbs. thrust). The " Piméné " recently successfully concluded a 150-hour test run and will be installed as auxiliary power plant (with a 16-inch diameter and 120-pound weight) in the Castel-Mauboussin CM. 8-R 13 sailplane of the Fouga aircraft works.

It is not impossible that a transfer to supersonic compressors (in infrasonic turbines) will take place in the near future in order to improve the economy. The method promises higher compression ratios with smaller compressor dimensions. Moreover, the heat developed by pressure shocks cannot be dissipated. —Last but not least, some new enthusiasm is being shown for the " *ducted fan* ", i.e. for a secondary air blower driven by an independent turbine wheel in order to increase the air mass shifted and consequently the efficiency of propulsion [3].

Research and development are meanwhile continuing without interruption. But for reasons of reliability, the power plants developed are required to be a stage behind, i.e. several years older and tested by time, than the prototypes and commercial transport aeroplanes in which they are installed. The successfully tested engines of to-day will service the aircraft of to-morrow; the newest high-performance experimental power plant will become operational only in a few years. Nevertheless, they may power our long-distance transports of the sixties.

[3] Conference held by F. M. Owner and Dr. S.G. Holder (Bristol Aeroplane Co.) at the fourth *World Power Conference* in London in July, 1950.

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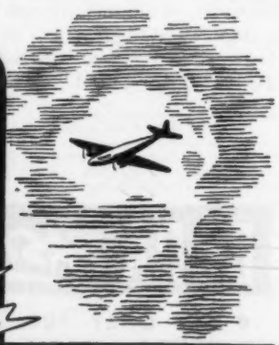

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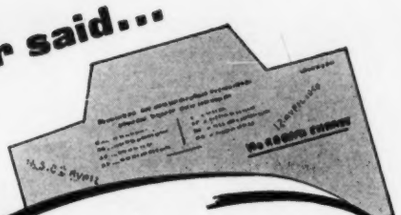

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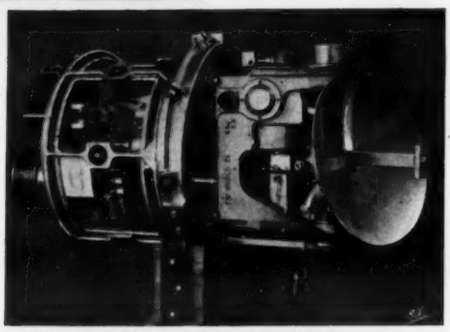

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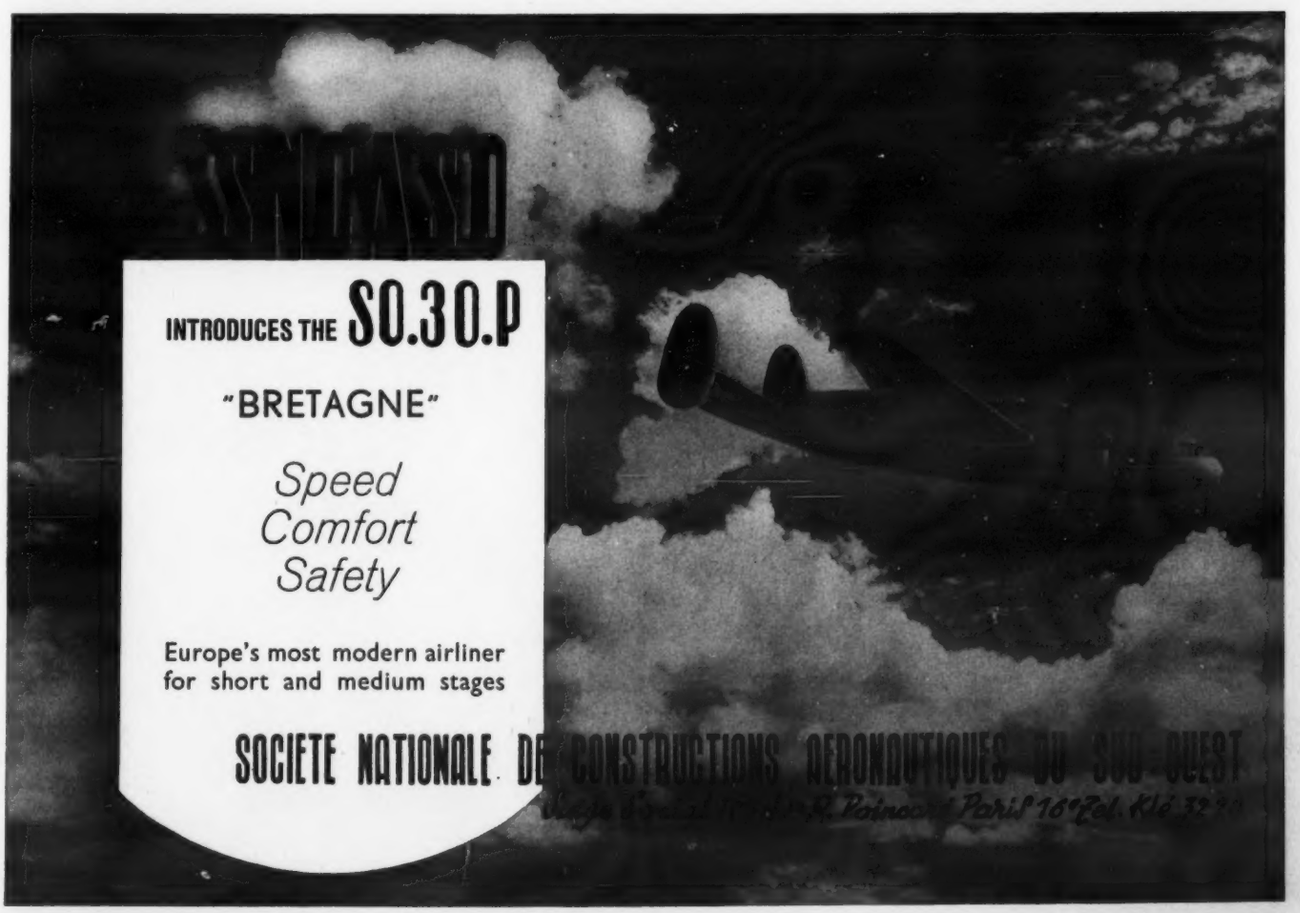

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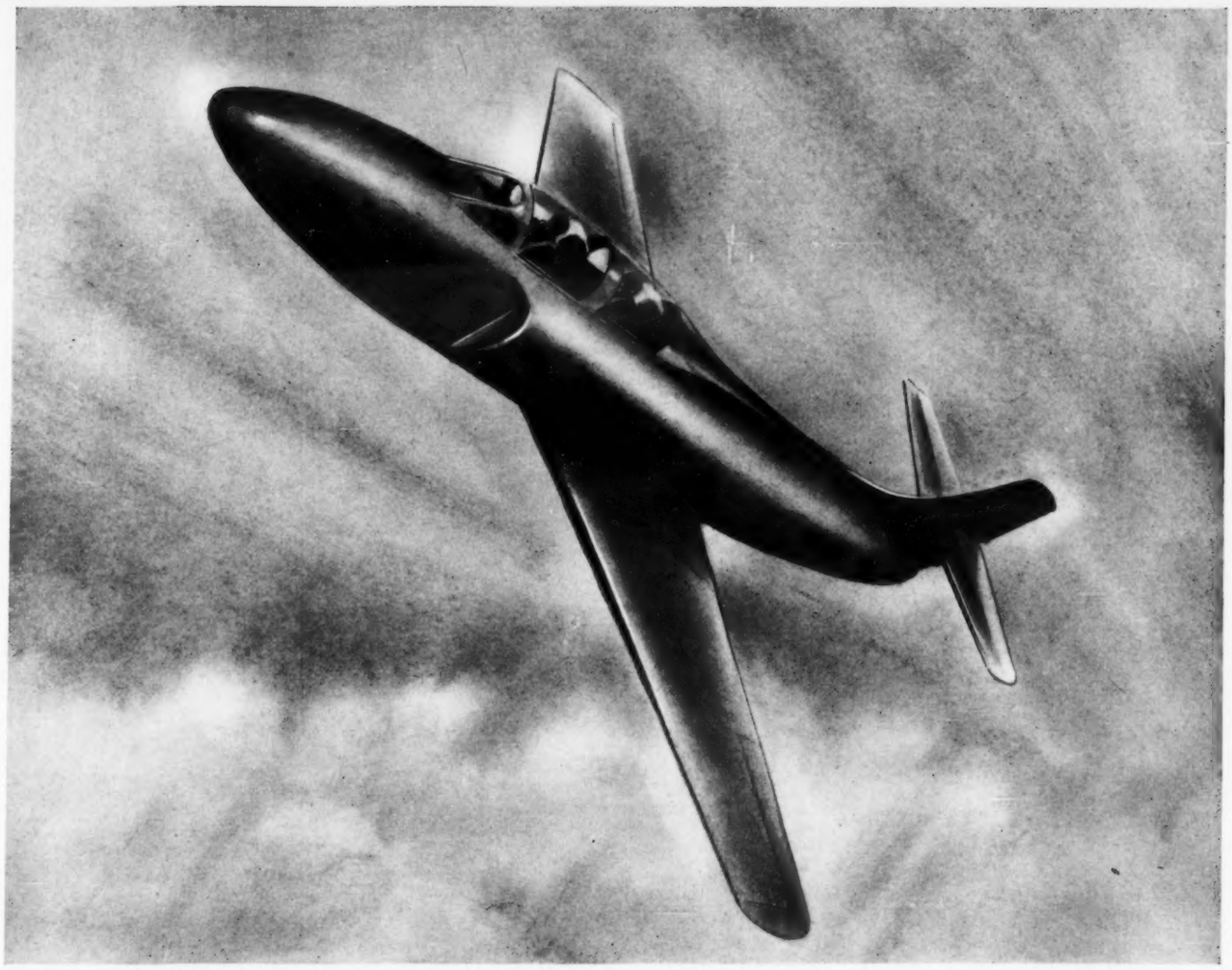

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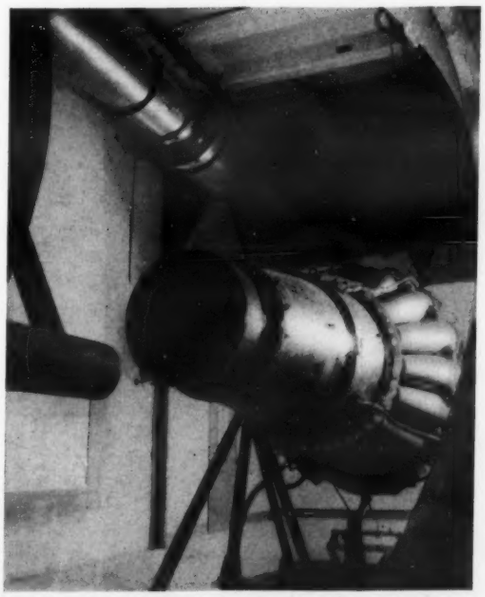

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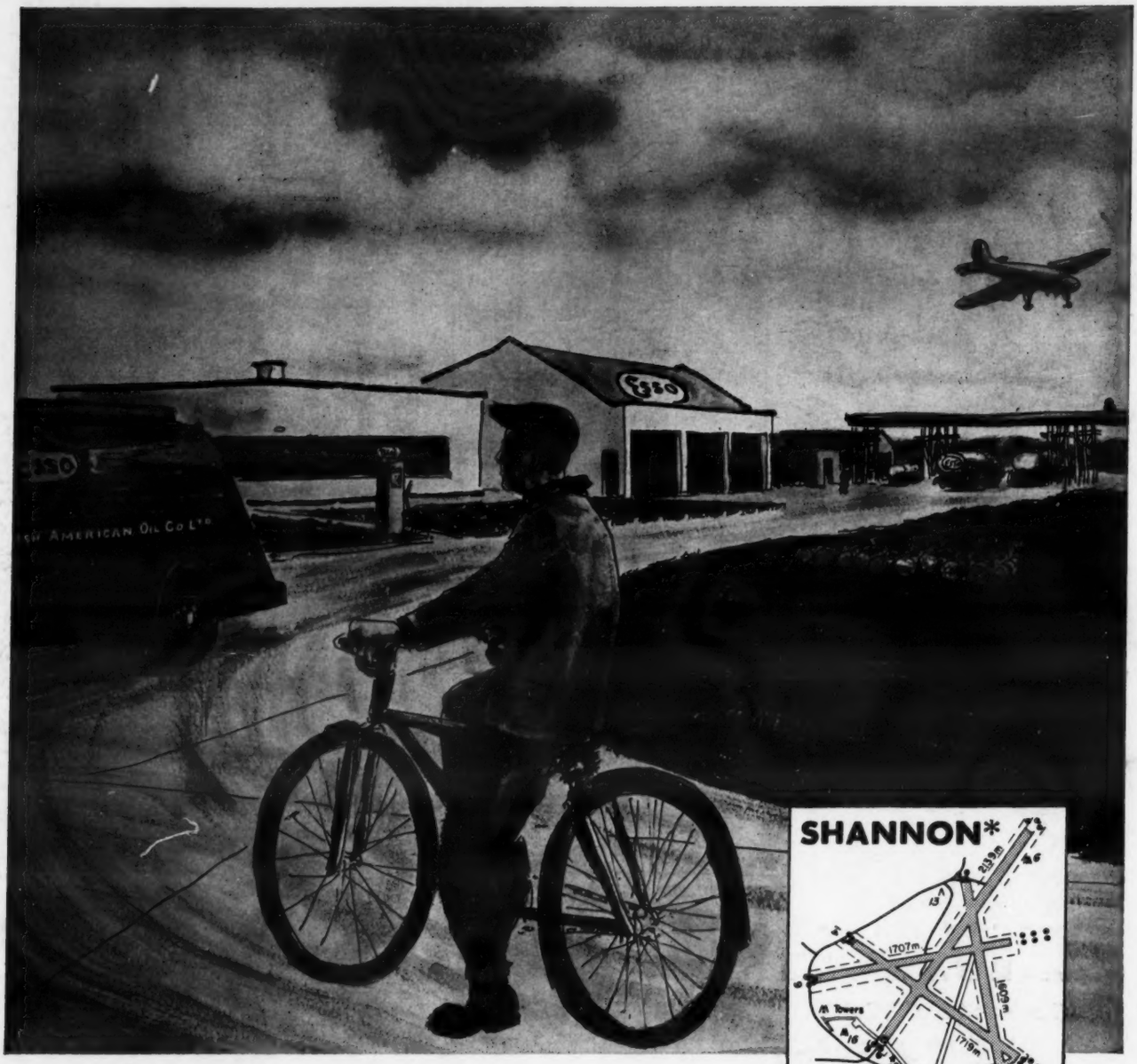

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